COLONY OF MAURITIUS

DEPARTMENT OF AGRICULTURE

SEVENTH ANNUAL REPORT OF THE SUGARCANE RESEARCH STATION, FOR THE YEAR 1936.

Printed by R. W. Brooks, Government Printer, Port Louis, 1937.

TABLE OF CONTENTS

	Page
Introduction, by Officer in charge	5
Part I—Cane Breeding : Report by Senior Geneticist ...	5
Part II—Bio-Chemistry : Report by Scientific Assistant ...	19
Part III—Research Botany : Report by Physiological Botanist ...	33
Appendix—List of Publications of the Sugarcane Research Station ...	44

SUGARCANE RESEARCH STATION, MAURITIUS

STAFF

Senior Geneticist, in Charge: A. G. G. Hill, B.A., B. Agr., A.R.C. Sc., I.

Bio-Chemist: N. Craig, M.Sc.

Physiological Botanist: H. Evans, Ph. D.

Cane Breeding Officer: A. de Sornay, Dip. Agric. (Maur.), I.A.C. (Paris)

Scientific Assistants: P. Halais, Dip. Agric. (Maur.); G. Mazery, Dip. Agric. (Maur.); A. d'Emmerez de Charmoy, Dip. Agric. (Maur.)

Agronomist: (Attached for part time services only) A. North Coombes, B.Sc., Dip. Agric (Maur.)

Clerical Assistant: (part-time services only) E. Gerard.

RESEARCH ADVISORY COMMITTEE OF THE SUGARCANE RESEARCH STATION FOR 1956.

The Director of Agriculture—*Chairman.*

The Senior Geneticist.

The Bio-Chemist.

The Physiological Botanist.

J. Doger de Spéville, Esquire.

P. de Sornay, Esquire., *Chevalier de la Légion d'Honneur.*

F. N. Coombes, Esquire.

G. Wiéhé, Esquire,

G. P. Langlois, Esquire.

Seventh Annual Report of the Sugarcane Research Station, for the Year 1936

INTRODUCTION

By the Officer in Charge

The Station was below strength for more than half of the year as Mr. N. Craig, Bio-Chemist, and Mr. G. Mazery, Scientific Assistant, were absent, from the 9th June and the 12th April, respectively, until the end of the year.

A meeting of the Research Advisory Committee was held in March at which the 1936–37 research programmes for cane-breeding, bio-chemistry and physiology were discussed and approved.

As further clones for testing accumulate year by year the land available for experimental purposes at Réduit (19½ arpents*) and Pamplemousses (14 arpents) is now insufficient for the work of the three divisions of the Station. Were it not for the help and generosity of numerous Planters who have placed land and labour at our disposal it would be impossible to carry out the present research programme.

The Mauritius College of Agriculture and the Sugar Industry Reserve Fund of the Chamber of Agriculture contributed Rs. 18,000 and Rs. 14,000 respectively towards the cost of the Station for the financial year 1936–37 the balance of Rs. 34,000 being met from Colonial Government Funds.

Steady progress was made with the research programmes of the three divisions of the Station, detailed reports on which follow below.

PART I—CANE-BREEDING

By A. Glendon Hill

General

The year was notable for the great promise shown by the newly released clone M. 171/30 which outyielded its controls in field trials, on the average, by 26% (vide Appendix III). This excellent clone, bred from R.P. 6 × M. 27/16, has already been given out to about fifty centres and by next season should be distributed throughout the Island.

During recent years the variety B.H. 10(12), introduced in 1920 but occupying only 7% of the cane area in 1933, has sprung into considerable prominence, especially in the warmer districts, so that should it continue to spread at its present rapid rate the cane-breeders' problem may soon be to find a successor, not for White Tanna, but for this variety. In the writer's opinion, this will be found possible, judging by the performance of new clones like M.171/30, M.72/31, M.73/31 and M.134/32 when tested against BH. 10(12), which is now being used as the control variety in most yield trials.

Crossing Programme, 1936.—This was based on a careful analysis of the parents used during the past six years and resulted in the elimination of many unproductive crosses.

The crossing season, in spite of high winds reaching 40 m.p.h. at times, was again successful making the seventh favourable season in succession.

A list of the crosses made during the year is given in Appendix I below, while a summary of the breeding work compared with that of previous years is given in Appendix II.

---

* 1 arpent = 1.043 acres.

Owing to the absence on leave of my Scientific Assistant, all crossing work, except for three selfings, was carried out at Réduit, after which half the fuzz of most crosses was sent to the lowland station at Pamplemousses and the rest sown at Réduit. In all 208 crosses were carried out of which eight were made for dispatch to the Director of Plant Breeding, New South Wales. The total number of seedlings raised in boxes was 38,000 of which 27,000 were bred by the open method, 7,000 by the bag method and 4,000 by the lantern method.

It is possible that at some future date almost all breeding work will be carried out in the uplands at Réduit because there are distinct indications that the number of selected clones in any batch of 1st year seedlings is higher amongst those bred in the uplands than in seedlings of the same parentage bred in the lowlands at Pamplemousses.

A workable emasculator for sugarcane flowers, based on the design of a clover emasculator described in the U.S.A.*, was devised during the arrowing season. This apparatus consisted of a small drawn glass jet connected by a convenient length of india-rubber pressure-tubing to the intake manifold of a 10 h.p. car, a vacuum flask being interposed in the pipe-line to equalise suction and to trap the pollen and anthers drawn in†.

1st-Trial Seedlings.—By the end of December all potted seedlings had been transplanted into the field, 10,800 at Réduit and 7,700 at Pamplemousses. A considerable number of seedlings of the cross R.P. 6 × M.27/16 were planted out at each Station as this combination had given excellent results in the past. In the case of this cross and certain others, sprouted single-eye cuttings of both parents were interplanted amongst their progeny in the field to allow inheritance studies to be undertaken next season.

During the crop period, 185 selections, representing 1.2% of the total, were made from the 1st-year population of 14,700 raised in 1935. Cuttings of these selections, instead of being planted direct in small-scale yield trials, were put into multiplication plots preparatory to testing them. This procedure, although it entails delay, has certain advantages as, apart from allowing one to replant at the proper season with good and ample planting material, it allows excessive vigour time to abate and, in addition, shows up the varying degrees of vigour existing amongst the selections, so that the fast and the slow growers can be grouped correctly in their subsequent tests.

2nd-Trial Seedlings.—Seven 2nd-trials containing 68 clones were laid down during the year and 14 trials containing 146 clones harvested, from which 22 selections, or 15%, were retained for 3rd-trials.

3rd-Trial Seedlings.—Five of these trials, containing 23 selections, were laid down and 22 harvested. From these 20 clones were retained for field trials, no clone being selected unless it had outyielded the control variety, usually BH. 10(12), and was satisfactory in other respects. A tabular summary of the performance of these selections, in their 3rd-trials, compared with their controls is given in Appendix III below. Amongst the most promising of these clones are :—M.65/31, M.127/32, M.130/32 and M.134/32 all of which are 4th-nobilised glagah types.

The recently adopted practice of leaving a buffer row on the long sides of each individual plot in all 3rd-trials has proved very useful, for, in addition to minimising varietal interaction, these non-experimental rows, if left standing at harvest, provide planting material for further trials, allowing one ample time to work out the statistical significance of the results, before making one's selections.

*Vide Journ. Amer. Soc. Agron., Sept. 1935.

†For a description of this apparatus see Trop. Agric. Vol. XIV No. 5.

In addition to yield and disease-resistance trials, the following additional information was, for the first time, determined in the case of the most promising clones in 3rd-trials :—

(i) *Defecation quality of juice*—undertaken as it was thought, correctly, that certain seedlings of POJ. 2878 might give trouble during defecation like the parent cane.

(ii) *Percentage of internodes attacked by cane borers*—prompted by the observation that infestation varied enormously between varieties, an important consideration in a country where borers periodically cause enormous damage.

(iii) *Percentage of fibre in cane.*—undertaken as it was thought that the factorial method of calculating sucrose % cane might be fallacious. (The factorial method has only been used in experimental work).

Field trial selections.—A summary of the results from 16 field trials cut during the year is given on p. 13 below. Apart from the Mauritius seedlings M. 108/30, M. 171/30 and M. 73/31, the most successful varieties in these trials were :—BH.10(12), POJ.2727, POJ.2878 and Selangor Seedling.

In the last annual report reference was made to the fact that the most promising varieties bred to date had been distributed to over thirty centres for multiplication. As a result, eight co-operative yield trials have already been laid down with these varieties on representative estates, while in other cases these canes are being tested in trials conducted by the estates themselves. It is proposed to keep up this practice so as to ensure that the best of the new clones are tested throughout the Island as soon as possible after passing through their 3rd-trials.

Released varieties.—The following new varieties were released for general distribution during the year on the recommendation of a committee consisting of the writer, the Mycologist, the Senior Agricultural Officer and the Assistant Entomologist :—M.171/30, M.72/31 and M.73/31.

Many of the most promising varieties from 3rd-trials cut in 1936 were handed over to the Senior Agricultural Officer for multiplication on the assumption that some of them will be released in 1937 when the results of field trials become available.

Phytalus Resistant Varieties.—The clone M. 108/30 released for general distribution in 1935 and recommended for planting in Phytalus infested areas, has lived up to its early promise.

So far the only really successful combination yielding clones suitable for Phytalus lands is POJ. 2878 × Uba Marot, a cross that produces seedlings which, unfortunately, almost always arrow, although admirable in many other respects. However, largely owing to the assistance of Mr. F. A. Nichols of Britannia Estate, who undertook some time ago to plant out a really large 1st-year population of this cross, two desirable non-arrowing clones M. 167/32 and M. 168/32, have now been obtained. Judging by their yields, under Phytalus conditions, in their 2nd and 3rd-trials, these two varieties should go far towards solving the variety problem in Phytalus infested areas.

A number of seedlings of the above parentage were back crossed with noble canes during the crossing season to improve the type.

I desire to place on record my appreciation of the manner in which the staff of the Station have worked, during the year, for the common end in view and to acknowledge the assistance rendered by the Mycologist, the Assistant Sugar Technologist and the Assistant Entomologist of the Department of Agriculture during the course of certain investigations which were outside the scope of the Station.

Réduit, January, 1937. A. GLENDON HILL.

APPENDIX I

LIST OF CROSSES MADE DURING 1936

I. Crosses Between "Noble" Canes

Combination			Location of Cross	No. of crosses made	No. of seedlings obtained C.E.S.	No. of seedlings obtained P.E.S.	No. of seedlings planted in field C.E.S.	No. of seedlings planted in field P.E.S.
Black Tanna	×	M. 27/16	C.E.S.	1	15	...	12	...
"	×	Sc. 12/4	do	1	0	...	0	...
B. 6308	×	M. 109/26	do	1	3	...	0	...
Ba. 11569	×	D. 1135	do	1	60	63	51	39
"	×	M. 23/16	do	1	35	20	0	12
"	×	M. 27/16	do	1	160	143	120	78
"	×	M. 35/17	do	1	25	38	15	15
"	×	M. 7/23	do	1	9	5	0	0
"	×	SC. 12/4	do	1	115	500	90	234
Fotiogo	×	M. 27/16	do	1	45	...	0	...
Louzier	×	M. 23/16	do	1	0	3	0	0
"	×	SC. 12/4	do	1	75	...	0	...
M. 20/16	×	M. 27/16	do	1	2	...	0	...
"	×	SC. 12/4	do	1	305	860	240	117
M. 14/26	×	M. 109/26	do	1	1	...	0	...
M. 12/29	×	D.K. 74	do	1	20	...	15	...
"	×	M. 27/16	do	1	65	70	60	60
"	×	SC. 12/4	do	1	0	...	0	...
R. P. 6	×	D. 109	do	1	70	...	60	...
"	×	M. 23/16	do	2	425	..	346	...
"	×	M. 27/16	do	2	875	500	800	324
"	×	M. 35/17	do	1	50	...	45	...
R. P. 6, str.	×	M. 27/16	do	1	20	...	0	...
Str. Tanna St. Félix	×	M. 27/16	do	1	0	...	0	...
55. P	×	M. 23/16	do	1	320	220	150	182
"	×	M. 109/26	do	1	245	...	225	...
"	×	SC. 12/4	do	1	308	...	280	221
			Total ...	29	3,245	2,422	2,509	1,282

II. Interspecific Crosses

1. 2nd Nobilised Glagah :—

Kassoer	×	M. 27/16	C.E.S.	1	0	...	0	...
			Total ...	1	0	...	0	...

2. 3rd Nobilised Glagah :—

P O J. 2364	×	D. 109 str. sport	C.E.S.	1	200	240	176	90
"	×	M. 27/16	do	1	40	...	30	...
"	×	M. 29/16	do	1	5	..	0	...
"	×	M. 35/17	do	1	2	...	0	...
"	×	M. 109/26	do	2	6	...	0	...
"	×	87. P.	do	1	400	...	80	78
			Total ...	7	653	240	286	168

II. Interspecific Crosses—*Continued*

Combination			Location of Cross	No. of crosses made	No. of seedlings obtained C.E.S	No. of seedlings obtained P.E.S.	No. of seedlings planted in field C.E.S.	No. of seedlings planted in field P.E.S.
3. 4th Nobilised Glagah :—								
Louzier	×	POJ. 2878	C.E.S.	1	0	...	0	...
M. 20/16	×	"	do	5	182	395	140	130
M. 33/19	×	"	do	5	20	12	...	...
M. 12/29	×	"	do	2	40	20	30	...
M. 13/30	×	"	do	1	...	...	...	...
POJ 2727	×	D. 109	do	2	22	...	0	...
"	×	" white sport	do	2	48	35	0	30
"	×	M. 12/21	do	2	0	...	0	...
"	×	M. 7/23	do	2	0	...	0	...
"	×	R.A. 7/24	do	2	0	...	0	...
"	×	87. P.	do	2	317	246	260	140
"	×	103/06	do	1	0	...	0	...
POJ. 2878	×	B. 3390	do	2	0	25	0	0
"	×	D. 109	do	2	90	28	80	24
"	×	D. 109, str. sport	do	1	60	44	40	30
"	×	D. 109, white sport	do	1	0	...	0	...
"	×	D. 1135	do	1	130	119	120	105
"	×	DK. 74	do	3	30	49	0	20
"	×	M. 23/16	do	1	2	...	0	...
"	×	M. 27/16	do	1	16	9	0	0
"	×	M. 35/17	do	2	207	228	105	130
"	×	M. 45/19	do	1	0	...	0	...
"	×	M. 12/21	do	1	3	0	...	0
"	×	M. 7/23	do	1	80	57	60	39
"	×	M. 109/26	do	10	460	166	370	135
"	×	SC. 12/4	do	2	0	...	0	...
"	×	87. P	do	2	410	1,200	200	65
R.P. 6	×	POJ 2878	do	3	1	...	0	...
55. P	×	"	do	8	90	26	45	0
131. P	×	"	do	2	250	350	220	270
		Total ...		71	2,458	3,009	1,670	1,118
4. 5th Nobilised Glagah :—								
Ba. 11569	×	M. 72/31	C.E.S.	2	700	587	640	535
"	×	POJ. 29/40	do	2	100	15	80	8
M. 20/16	×	M. 72/31	do	2	285	470	260	252
M. 1/17	×	M. 73/31	do	2	0	...	0	...
M. 73/31	×	B. 3390	do	1	60	16	42	14
"	×	D. 109	do	1	365	400	320	330
"	×	" white sport	do	1	400	700	328	372
"	×	D. 1135	do	4	1,725	410	460	600
"	×	M. 27/16	do	2	305	505	260	190
"	×	M. 29/16	do	2	56	...	30	...
"	×	M. 35/17	do	1	200	340	140	210
"	×	M. 7/23	do	1	20	6	0	3
"	×	M. 24/25	do	1	130	0	100	...
"	×	M. 37/26	de	2	3,000	...	260	300
"	×	M. 109/26	do	2	4	...	0	...
"	×	SC. 12/4	do	1	1	2	0	...
"	×	87. P	do	2	125	132	100	120
R.P. 6	×	M. 72/31	do	1	610	...	519	...
55. P	×	"	do	2	2,000	450	260	165
131. P	×	"	do	2	25	22	15	13
		Total ...		34	10,111	4,055	3,814	3,112
5. Chunnee Crosses :—								
POJ. 213	×	M. 29/16	C.E.S.	1	0	...	0	...
"	×	M. 7/23	do	2	0	...	0	...
"	×	SC. 12/4	do	1	0	...	0	...
		Total ...		4	0	...	0	...

INTERSPECIFIC CROSSES.—*Continued*

COMBINATION	Location of Cross	No. of crosses made	No. of seedlings obtained C.E.S.	No. of seedlings obtained P.E.S.	No. of seedlings planted in field C.E.S.	No. of seedlings planted in field P.E.S.
6. Saccharum Munja Crosses :—						
M.20/16 × S. Munja	C.E.S.	1	20	27	0	18
Total ...		1	20	27	0	18
7. Other Combinations :—						
Ba 11569 × M. 34/31	C.E.S.	1	5	5	0	2
" × M. 36/31	do	1	22	11	0	0
" × M. 196/31	do	1	40	25	22	15
" × Selangor Seedling	do	2	0	...	0	..
BH. 10 (12) × M. 196/31	do	1	2	...	0	...
Fotiogo × do	do	1	4	4	0	0
Louzier × do	do	1	3	1	0	0
M. 20/16 × do	do	2	180	550	154	324
" × Selangor Seedling	do	3	50	88	45	45
M. 33/19 × do	do	3	30	25	0	15
M. 26/20 × do	do	2	65	45	0	20
M. 14/26 × do	do	2	0	...	0	...
M. 109/26 × M. 196/31	do	3	405	370	340	150
" × Selangor Seedling	do	3	715	365	500	162
M. 108/30 × D. 109	do	3	20	20	12	14
" × 87. P	do	2	425	380	350	260
M. 73/31 × Selangor Seedling	do	5	55	23	0	21
POJ. 2727 × M. 196/31	do	1	0	...	0	...
" × Uba Marot	do	1	0	...	0	...
POJ. 2878 × M. 196/31	do	1	250	273	225	180
" × Uba Marot	do	2	2,500	3,000	294	270
RP. 6 × M. 196/31	do	1	55	24	45	18
" × Selangor Seedling	do	1	100	145	80	90
RP. 6 striped sport × do	do	1	0	...	0	...
55.P × M. 196/31	do	2	70	3	30	...
" × Selangor Seedling	do	3	135	21	120	12
131. P × M. 196/31	do	2	1,000	550	300	450
" × Selangor Seedling	do	3	50	...	0	...
Total ...		54	6,181	5,928	2,517	2,048
Total ...		172	19,423	13,259	8,287	6,464
III.—INTERGENERIC CROSSES						
33/95 × Sorgho	C.E.S.	1	1	...	0	...
Total ...		1	1	...	0	...
IV.—SELFINGS						
B. 6308	C.E.S.	1	0	...	0	...
DK. 74 (castrated)	do	1	0	...	0	...
DK. 74	do	1	0	...	0	...
M. 212/32	P.E.S.	1	6	10	3	10
M. 213/32	do	1	7	...	5	...
M. 216/32	do	1	0	0	0	...
Total ...		6	13	10	8	10
V.—RECAPITULATION TABLE						
1. Crosses between " Noble " canes ...		29	3,245	2,422	2,509	1,282
2. Interspecific crosses ...		172	19,423	13,259	8,287	6,464
3. Intergeneric crosses ...		1	1	0	0	0
4. Selfings		6	13	10	8	10
Total		208	22,682	15,691	10,804	7,756

APPENDIX II

Summary of Cane-Breeding Work 1930 to 1936

	1930	1931	1932	1933	1934	1935	1936
Controlled crosses made, including selfings	409	355	457	466	421	356	208
Uncontrolled crosses	569	370	46	1	nil	nil	nil
1st Year seedlings raised in boxes	52,840	72,888	157,948	64,883	95,105	78,572	38,000
" " planted out on experimental stations ...	18,888	22,011	23 016	18.993	20,734	14,724	18,500
" " distributed to estates for planting	3,000	5,000	16,040	3,645	4,550	nil	500
Selections made from 1st-year populations for 2nd-trials ...	233	263	252	250	180	185	...
" " " 2nd-trials above for 3rd-trials	46	56	60	23*	...	...	...
" " " 3rd-trials above for field trials	13	6*	4*	...	...	...	...
" still retained	9	...	...	...	..	...	...

*Not yet completed.

APPENDIX III

Performance of all 3rd Trial Seedlings* Selected to-date for Field Trials compared with the yields of controls same experiment.

Seedling No.	Parentage			Cane tons arpent	Sucrose tons arpent	Control Variety	Cane tons arpent	Sucrose tons arpent	Location of Trial
M. 5/30	R.P. 6	×	131.P	24.7	3.08	White Tanna	12.8	1.68	Réduit
M. 10/30	„	×	„	18.7	2.36	do	12.8	1.68	do
M. 13/30	R.P. 6 (uncontrolled)			15.3	2.00	do	12.8	1.68	do
M. 28/30	Ba. 11569	×	M. 27/16	30.1	4.67	do	11.4	1.63	do
M. 28/30	„	×	„	26.4	3.60	BH. 10 (12)	24.8	3.77	Mon Rocher
M. 48/30	R.P. 6	×	Senneville	37.7	5.34	do	24.8	3.77	do
M. 71/30	Ba. 11569	×	131. P	43.4	6.16	White Tanna	11.4	1.63	Réduit
M. 106/30	P.O.J. 2878	×	Uba Marot	55.4	6.93	do	11.4	1.63	do
M. 106/30	„	×	„	38.5	4.75	do	18.9	2.86	Gros Bois
M. 108/30	„	×	„	40.0	5.71	do	11.4	1.63	Réduit
M. 108/30	„	×	„	33.8	5.02	do	18.9	2.86	Gros Bois
M. 113/30	R.P. 6	×	M. 23/16	65.4	8.57	BH. 10 (12)	46.0	6.03	Mon Rocher
M. 151/30	„	×	M. 35/17	...	...	.....	...	...	.....
M. 163/30	M. 20/16	×	„	56.1	7.28	BH. 10 (12)	46.0	6.03	Mon Rocher
M. 163,30	„	×	„	58.7	8.15	M. 27/16	55.3	7.51	Réduit
M. 171/30	R.P. 6	×	M. 27/16	68.1	10.27	do	55.3	7.51	do
M. 171,30	„	×	„	63.4	9.82	BH. 10 (12)	43.9	5.70	Mon Rocher
M. 186/30	„	×	131. P	44 8	5.13	do	43.9	5.76	do
M. 186/30	„	×	„	64.4	9.40	D.K. 74	44.2	5.96	Réduit
M. 9/31	POJ. 2878	×	Uba Marot	52.3	6.37	POJ. 2878	38.9	5 55	Mon Rocher
M. 22/31	„	×	„	53.3	6 86	do	38.9	5.55	do
M. 41/31	„	×	„	60.8	7.30	POJ. 2727	22.4	3.14	Réduit
M. 65/31	„	×	M. 37/26	53.1	7.65	BH 10 (12)	35.4	5,31	Mon Rocher
M. 72/31	„	×	M. 35/17	47.5	7.36	POJ. 2878	45.8	7.55	Réduit
M. 73/31	„	×	M. 109/26	50.5	7.98	do	45.8	7.55	do
M. 140/31	„	×	Senneville	47.9	6.85	BH. 10 (12)	31,9	5.68	Mon Rocher
M. 156/31	M. 1/17	×	M. 27/16	44.9	7.01	do	32.6	5.73	do
M. 196/31	POJ. 2878	×	Uba Marot	50.4	6.70	POJ. 2727	35.4	5 02	do
M. 196/31	„	×	„	46.5	5.25	do	...	...	Réduit
M. 20/32	M. 20/16	×	POJ. 2878	37.3	5.52	B.H. 10 (12)	25.7	4.54	Mon Rocher
M 62/32	POJ. 2878	×	Uba Marot	63.9	8.93	POJ. 2828	37.7	6.07	Réduit
M. 108/32	„	×	„	41.9	6.25	POJ. 2727	35.4	5.02	Mon Rocher
M. 127/32	„	×	D. 109 (w)	51.3	7.34	BH. 10 (12)	36.3	5.41	do
M. 130/32	R.P. 6	×	POJ. 2878	47 7	7.10	do	36.3	5.41	do
M. 134/32	POJ. 2878	×	D. 109	57.5	8.39	do	39.8	6.29	do

* As plant canes only.

RESULTS OF VARIETY TRIALS CUT IN 1936

Trial No. 17, Réduit C.E.S.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
POJ 2878 ...	6.04	33.2	18.2	94.8	20.2
R.P. 8	4.90	32.0	15.3	92.8	0.0
POJ. 2727 ...	4.80	27 0	17.8	93.8	10.2
S.E.	±0.31				

Third ratoons aged 12 months. Cut : 15.10.36, and in 1935 on 11th October. Irrigated.

POJ. 2878 was significantly better than R P. 8, the standard. The difference between R.P. 8 and POJ. 2727 was not significant.

Trial No. 45, St. Antoine S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (factorial richesse)	Purity	Arrows % canes
POJ. 2727 ...	7.33	47.3	15.5	82.6	22.0
Selangor Seedling ...	6.58	38.9	16.9	90.8	2.4
B H. 10 (12) ...	5.10	29.0	17.6	92.1	0.0
POJ. 2940 ...	4.67	27.5	17.0	91.7	14.7
S C. 12/4	4.04	24.9	16.2	91.5	1.3
S.W. 499	3.73	22.3	16.7	90,4	<1.0
D.I. 52	3.56	20.0	17.8	91.1	0.0
Mean	5.00				
S.E.	±0 16				
Significant difference...	0.54				

Second ratoons aged 12½ months. Cut: 4.8.36, and in 1935 on 22nd July. Lay-out : randomised blocks, without border rows.

POJ. 2727 and Selangor Seedling were both significantly better than BH. 10 (12), the standard.

Trial No. 73, St. Antoine S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
POJ. 2727 ...	5.31	35.9	14.8	86.0	27.5
Selangor Seedling ...	4.72	31.7	14.9	87.5	<1
BH. 10 (12) ...	4.08	25.0	16.3	91.5	0
M. 27/16	3.94	28.7	13.7	89.3	0
D. 109 (white) ...	3.92	27.4	14.3	88.5	15.2
SC. 12/4	3,00	21.2	14.2	91.5	0
Mean	4.16				
S.E.	±0.26				
Significant difference...	0.90				

First ratoons aged 11½ months. Cut : 5.8.36 and in 1935 on 29th August. Lay-out . randomised blocks, with border rows discarded.

POJ. 2727 was significantly better than M. 27/16, the standard. SC. 12/4 was significantly inferior to M. 27/16.

Trial No. 74, Rich Fund S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
S.W. 499	6.57	41.8	15 7	90.0	4
Selangor Seedling ...	6.44	39.1	16.5	94.1	54
B H. 10 (12) ...	6.25	41.1	15 2	92.0	0
S C. 12/4	5.98	40.4	14.8	93.9	8
POJ. 2940 ...	5.79	32.3	17.9	94.1	63
POJ. 2727 ...	5.69	33.9	16 8	92.3	39
POJ. 36	5.39	36.6	14.7	92.1	48
Mear.	6.01				
S.E.	±0.23				
Significant difference...	0.78				

First ratoons aged 11½ months. Cut : 17.8.36, and in 1935 on 2nd September. Not irrigated. Lay-out : randomised blocks without border rows.

There was no significant difference between BH. 10 (12), the standard, and the other varieties, except POJ.36 which was significantly inferior.

Trial No. 75, St. André S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose% cane (true richesse)	Purity	Arrows % canes
Selangor Seedling ...	6.96	40.9	17.0	89.7	20.6
POJ. 2878	6.84	41.2	16.6	93.2	24.7
POJ. 2727	6.35	41.5	15.3	91.0	26.4
R.A. 30	5.36	35.5	15.1	93.7	3.0
BH. 10 (12)	5.35	29.9	17.9	94.6	< 1.
M. 55/1182	5.15	33.7	15.3	92.6	2.3
D. 109 (red)	4.63	28.4	16.3	92.6	5.0
Mean	5.81				
S.E.	±0.22				
Significant differenee ...	0.76				

First ratoons aged 11½ months. Cut : 1-2.10.36, and in 1935 on 15th October. Irrigated. Lay-out : randomised blocks, with border rows discarded.

Selangor Seedling, POJ. 2878 and POJ. 2727 were, in this order, significantly better than D. 109 (red) the standard.

Trial No. 76, St André S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose% cane (true richesse)	Purity	Arrows % canes
M. 27/16	5.39	35.7	15.1	91.8	9.0
M. 14/26	5.34	34.0	15.7	94.2	5.9
M. 109/26	5.24	32.8	16.0	91.4	29.6
D. 109 (white)... ...	4.96	30.8	16.1	93.1	4.0
D.K. 74	4.83	29.6	16.3	93.8	1.9
D. 109 (red)	4.67	28 9	16.2	92.2	4.2
White Tanna (Mon Désert) ...	4.37	28.6	15.3	90.8	3.0
Mean	4.97				
S.E.	±0.24				
Significant Difference ...	0.83				

First ratoons aged 11½ months. Cut 2.10.36, and in 1935 on 15th October. Irrigated. Lay-out: randomised blocks, with border rows discarded.

There was no significant difference between any of the above varieties and D. 109 (red), the standard.

TRIAL No. 78, BEAU CHAMP S. E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
POJ. 2878	4.27	26.5	16.1	91.7	15.2
BH. 10 (12)	3.89	25.9	15.0	90.6	0
POJ. 2727	3.71	26.4	14.0	87.0	3.0
M. 27/16	3.62	24 8	14.6	92.4	0
M. 23/16	3.22	23.4	13.8	89.0	0
White Tanna	2.98	20.8	14.3	89.7	0
Mean	3.62	—	—	—	—
S.E.	±0.13				
Significant difference ...	0.46				

First ratoons aged 11½ months. Cut 11.11.36, and in 1935 on 25th November. Irrigated. Lay-out: randomised blocks, with border rows discarded.

M. 23/16 and White Tanna were both significantly inferior to BH. 10 (12), the standard. The differences between BH. 10 (12) and the other varieties were not significant.

TRIAL No. 82, TRIANON S. E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
M. 5/30	8.82	54.1	16.3	91.3	6.3
M. 13/30	7.22	47.9	15.1	91.6	8.0
M. 28/30	7.11	48.4	14.7	94.4	0
M. 10/30	6.57	42.4	15.5	92.8	0
D.K. 74	6.29	40 1	15.7	93.5	19.1
Mean	7.20	—	—	—	—
S.E.	±0.29				
Significant difference ...	1.00				

Virgins aged 21 months. Planted: 21.11.34. Cut: 27.8.36. Not irrigated. Lay-out: randomised blocks, with border rows discarded.

M.5/30 is the only variety significantly better than D.K 74, the standard; however, it is to be discarded as it is now proving susceptible to Gummosis.

TRIAL No. 83, GROS BOIS S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
M. 108/30	8.33	54.8	15.2	88.9	...
POJ. 2878	5.94	38.6	15.4	91.1	...
M. 106/30	5.50	43.6	12.6	83.9	...
POJ. 2727	4.80	32.0	15.0	88.8	...
White Tanna ...	4.63	33.1	14.0	89.6	...
G.B. No. 2	3.97	30.0	13.4	80.9	...
M. 7/23	3.50	23.3	15.0	92.5	...
Mean	5.24				
S.E.	±0.31				
Significant difference ...	1.18				

Virgins aged 21 months. Planted : 30.11.34. Cut : 23.9.36. Not irrigated. Lay-out : randomised blocks, with border rows discarded.

M. 108/30 and POJ. 2878 were significantly better than White Tanna, the standard.

TRIAL No. 94, LABOURDONNAIS S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
Selangor Seedling ...	4.41	27.9	15.8	90.1	...
BH. 10 (12) ...	3 67	21.3	17.2	92.6	...
POJ. 2727	3.65	25.2	14.5	87.3	...
S.C. 12/4	3.48	22.9	15.2	90.1	..
M. 13/18	3,05	21.9	13.9	87.1	...
S.W. 499	2.81	20.5	13.7 (F)*	86.0	.
M. 29/16	2.60	20.2	12 9 (F)*	86.2	...
Mean	3.38				
S.E. ...	...± 0.18				
Significant difference	... 0.63				

Virgins aged 13½ months. Planted : 3.7 35. Cut : 17.8.36. Not irrigated. Lay-out : randomised blocks, with border rows discarded.

Selangor Seedling was significantly better than B.H.10 (12), the standard.

TRIAL No. 95, LABOURDONNAIS S. E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose% cane (true richesse)	Purity	Arrows % canes
Selangor Seedling ...	3.70	22.7	16.3	93.0	...
BH. 10 (12) ...	3.63	20.4	17.8	94.7	...
M. 13/18 ...	3.49	23.4	14.9	89.8	...
M. 29/16 ...	3.49	22.8	15.3	88.1	...
POJ. 2727 ...	3.34	21.5	15.5	89.8	...
SC. 12/4 ...	3.34	20.4	16.4	93.7	...
S.W. 499 ...	2.98	18.6	16.0	89.2	...
Mean ...	3.42				
S.E. ...	±0.22				
Significant difference	0.77				

Virgins aged 13½ months. Planted : 5.7.35. Cut : 18.8.36. Not irrigated. Lay-out : randomised blocks, with border rows discarded.

No variety was significantly superior, or inferior, to BH. 10 (12), the standard.

*(F) = Factorial.

Trial No. 97, Mon Désert–Mon Trésor S.E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % cane (true richesse)	Purity	Arrows % canes
POJ. 2878 ...	6.22	40.6	15.3	89.7	8 2
Selangor Seedling	5.88	38.7	15.2	89.5	1.9
B H. 10 (12) ...	5.64	34.0	16.6	93.7	0
POJ. 2727 ...	5.59	38.3	14.3	87.1	5.3
S C. 12/4 ...	4.18	28.2	14.8	89.8	0
S.W. 499 ...	3 81	25.6	14.9	88.7	1 6
Mean ...	5.22				
S.E. ...	±0.37				
Significant difference	1.34				

Virgins aged 15 months. Planted : 23.7.35. Cut : 27.10.36. Not irrigated. Lay-out : randomised blocks, with border rows discarded.

No variety was significantly superior to BH. 10 (12), the standard.

Trial No. 98, Rich Fund S. E.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % Cane (true richesse)	Purity	Arrows % canes
BH. 10(12)	7.45	43.3	17.2	90.9	0
Selangor Seedling ...	6.28	43.3	14.8	89.0	20.0
POJ. 2727	6.20	41.3	15.0	89.9	14.0
SC. 12/4	6.03	39.4	15.3	94.8	2.8
POJ. 36	5.07	35.2	14.4	88.9	5.6
Mean	6.20	—	—	—	—
S.E. ...	±0.47	—	—	—	—
Significant difference ...	1.71	—	—	—	—

Virgins aged 14½ months. Planted : 3 9.35. Cut : 18 11.36. Not irrigated. Lay-out : ramdomised blocks, with border rows discarded.

POJ. 36 was significantly inferior to BH.10(12), the standard.

Trial No. 99, Reduit C.E.S.

Variety	Sucrose tons per arpent	Cane tons per arpent	Sucrose % Cane (true richesse)	Purity	Arrows % canes
M. 171/30 ...	7.74	54.9	14.1	89.3	0
M. 73/31 ...	7.72	53.6	14.4	92,5	0
M. 186/30 ...	6 04	47.9	12.6	86.9	0
M. 163/30 ...	5.93	48.2	12.3	87.2	0
M. 27/16	5.90	44.0	13.4	91.1	0
Mean	6.67	—	—	—	<1
S.E.	±0.23	—	—	—	—
Significant difference ...	0.78	—	—	—	—

Virgins aged 14½ months. Planted : 15.9.35. Cut : 4.12.36. Irrigated. Lay-out : randomised blocks, with border rows discarded.

M. 171/30 and M. 73/31 were both significantly better than M. 27/16, the standard. These canes have been released for general distribution. M. 163/30 and M.186/30 have been discarded as they are susceptible to Gumming disease.

Trial No 100, Mon Rocher S.E.

Variety		Sucrose tons per arpent	Cane tons per arpent	Sucrose % Cane (true richesse)	Purity	Arrows % canes
M. 171/30	...	7.73	57.3	13.5	89.5	0
M. 113/30	...	6.51	47.1	13.8	90.0	0
BH. 10 (12)	...	6.35	44.4	14.3	91.6	0
M. 163/30	...	6.29	46.9	13.4	90.9	0
M. 73/31	...	5.79	44.2	13.1	89.7	0
M. 186/30	...	4.29	39.4	10.9	85.2	0
Mean	...	6.16	—	—	—	—
S.E.	...	±0.26	—	—	—	—
Significant difference	..	0.88	—	—	—	—

Virgins aged 14.3 months. Planted : 23.9.35. Cut : 3.12.36. Irrigated. Lay-out : randomised blocks, with border rows discarded.

M. 171/30 was significantly better than BH. 10 (12), the standard. The difference between M. 113/30, M. 73/31, M. 163/30 and BH. 10 (12) was not significant.

Trial No 101, Mon Rocher S.E.

Variety		Sucrose tons per arpent	Cane tons per arpent	Sucrose % Cane (true richesse)	Purity	Arrows % canes
M. 9/31	...	5.39	42.1	12.8	77.0	37.4
M. 108/30	...	5.25	34.3	15.3	89.2	29.4
M. 22/31	...	4.90	40.2	12.2	76.7	<1
M. 41/31	...	4.81	32.9	14.6	85.9	38.3
POJ. 2727	...	4.00	27.9	14.3	88.4	0
Mean	...	4.87	—	—	—	—
S.E.	...	±0.30	—	—	—	—
Significant difference	...	1.02	—	—	—	—

Virgins aged 11½ months. Planted : 27–28.9.35 ; Cut : 16.9.36. Irrigated. Lay-out : randomised blocks, with border rows discarded.

M. 9/31 and M. 108/30 were significantly better than POJ.2727, the standard.

PART II—BIO-CHEMISTRY

By Pierre Halais,

Scientific Assistant

PROGRAMME OF WORK

I. Soil Studies

1. Contrasting lateritic alteration with clay alteration.
2. New methods of soil analysis :—
   (*a*) Mechanical analysis—Ammonium carbonate (Puri 1935) Method compared with the International Method ; dispersion ratio.
   (*b*) "Humus" soluble in an alkali.
   (*c*) Exchangeable Potassium ; comparison between Ignition and Volk Truog Methods.
   (*d*) Exchangeable Magnesium, by the Bastisse 1936 Method.
   (*e*) Total Phosphorus dissolved by sulphuric-chlorate mixture of Emmert and comparison with P_2O_5 dissolved by concentrated HCl.
   (*f*) "Available" Phosphorus extracted by hot 1% Potassium Carbonate (Whitney and Gardener, 1936).

3. Phosphate Studies : dependence of "available" P_2O_5 (1% Potassium carbonate method) on total P_2O_5 and soil reaction ; key of interpretation for Phosphate needs.

4. Exchangeable bases. The relative proportion of Exchangeable bases (CaO, MgO, K_2O) in lateritic and clay soils ; Molecular $\frac{\text{Exchangeable CaO}}{\text{Exchangeable MgO}}$ ratio. The question of magnesium deficiency.

5. Relative change in soil composition with depth for cultivated mature lateritic soils : degree of laterisation, reaction, organic matter, exchangeable bases (CaO, MgO and K_2O) and "available" P_2O_5.

6. Soil surveys of sugar cane estates.

7. Pot experiment of Magnesium fertilizers with maize.

8. Foliar diagnosis of Lagatu and Maume on BH. 10 (12) canes. Physiological ratios ; Antagonism between bases.

II. Manurial Trials

1. Heavy dressings of chemicals compared to low dressings at Réduit. Border effect.

2. Farmyard manure plus chemicals compared to heavy doses of chemicals only, on virgins at St. André and Queen Victoria.

3. Straight Fertilisers compared to concentrated fertilisers at St. André and Queen Victoria.

4. Forms of phosphates, Rich Fund.

5. Nitrogen and Potash in presence or absence of Farmyard Manure at Bel Air St. Félix.

6. Nitrogen, Phosphate and Potash trial at Bénarès.

7. Other N.P.K. trials conducted at Grande Savanne.

The research programme formulated by the Bio-Chemist, Mr. N. Craig, was carried out as far as possible during his overseas leave of absence.

I. Soil Studies

1. A brief description of the two highly contrasty soil types found on the island, and derived from basaltic rocks, is a desirable prelude to the following report.

(a) *Soils of the Lateritic or Allitic alteration.*—These are the commonly occurring soils of the Colony and constitute practically the whole of the sugar cane area. These residual soils drain freely and have been leached of their bases and silica as a consequence of the rainfall to which they have been subjected, viz from 40 to 150 inches per annum. The deepest and more altered profiles are found on the oldest formations and constitute mature soils or "terres franches." On the other hand, immature soils or "terres rocheuses" are found on the younger formations and still contain much basaltic debris. The molecular Silica: Sesquioxide ratio of the physical clay ($< 2\,\mu$ fraction) varies from 0.15 to 1.20. These soils therefore range from true laterites (allites) to lateritic clays (allito siallites). The physical properties and moisture relationships of all these soils are good, as a result of the great stability of the soil aggregates. The base exchange capacity is comparatively low and decreases with depth, while there is about three times more calcium than magnesium in the exchange complex. The laterit c soils can "fix" considerable amounts of soluble phosphates. Their colour usually varies from reddish yellow to reddish brown.

(b) *Soils of the clay or siallitic alteration.*—These seem to be confined more to special topographical areas having impeded drainage than to special climatic or lithological conditions. The result is an accumulation of bases and silica in the profile, but it is not clear, however, whether they are residual or transported soils. Some degraded sub-types are probably present, even in the wetter parts of the island. The examples studied to date are located in Plain Lauzun, Vallée des Prêtres, Australia, Médine, La Mivoie and Yemen. These soils constitute the true c'ays or "siallites" of the Tropics. The molecular Silica/Sesquioxide ratio of the physical clay ($< 2\,\mu$ fraction) varies around 2.50. Their physical properties and moisture relationships may easily deteriorate on account of their heaviness and lack of structural stability. The base exchange capacity is very high and may increase with depth and the exchange complex contains as much magnesium as calcium in the top soil, and may even contain more in the sub-soils. These clay soils do not "fix" soluble phosphates to any great extent. Their colour is grey to dark grey and improvement by drainage is the first step to their successful cultivation.

2. New Methods of Soil Analysis

(a) *Mechanical Analysis and Dispersion ratio.*—The new boiling ammonium carbonate-lithium hydroxide method of Puri (1935) for mechanical analysis was compared with the International H_2O_2–HCl–NaOH method generally used in this laboratory, with the following results :—

Soil type		Mean organic matter % dry soil	Comparative indices for clay $< 2\,\mu$	
			International Method	Puri Method
Lateritic	5 top soils ...	6.4	100	44
	3 subsoils ...	0.8	100	65
Clay	2 top soils ..	6.6	100	94
	2 subsoils ...	1.6	100	102

In the Puri method, the results of the pipette sampling were corrected for organic matter rendered soluble during the treatment.

The much lower " dispersion ratio " $\left\{\frac{\text{clay by Puri method}}{\text{clay by Int. method}} \times 100\right\}$ for soils of the lateritic alteration, is a further proof of their strong stability in the field. This ratio could be used as a rough index to their liability to erosion etc.

(b) *" Humus " soluble in an alkali.*—The humus extracted by hot 1% Potassium carbonate solution (used by Whitney and Gardener (1936) for " available " P_2O_5) was determined on 40 lateritic top soils and subsoils by oxidation with permanganate (1 cc N/10 $KMnO_4$ = 1 mgr Humus). The results obtained show a perfect correlation with the total content of organic matter (R = + 0.99) and Potassium carbonate soluble " Humus " works out at approximately 46% of the total organic matter.

(c) *Exchangeable Potassium.*—A comparison was made on 24 lateritic soils and subsoils, between the ignition method previously used and the new Volk-Truog (1934) method of analysing ammonium acetate leachates for potassium. The mean of 24 parallel determinations was as follows ;—

mgrs K_2O% grm dry soil	
Ignition Method	Volk-Truog Method
11 mgrs	14 mgrs

The correlation coefficient between the results obtained by the two methods is excellent being (R = + 0.95). The Volk-Truog method is a definite improvement over the lengthy ignition method and will be extremely useful for detailed soil survey work.

(d) *Exchangeable Magnesium.*—The Bastisse (1936) method of determining Magnesium in Ammonium acetate leachates was applied to a large number of soils with the following results :

	Lateritic Alteration		Clay Alteration	
	Topsoils	Subsoils (up to 4 ft.)	Topsoils	Subsoils (up to 3 feet)
Samples examined ...	23	20	4	2
mgrs exch. MgO % grm dry soil (range) ...	165 mgrs to 7 „	50 mgr. to 3 „	602 mgr. to 174 „	907 mgr. to 792 „

(e) *Total Phosphorus.*—The sulphuric acid-chlorate oxidising mixture of Emmert was used to dissolve all the phosphorus and the phosphates determined colorimetrically, after reduction of ferric iron with sodium bisulphite according to Zinzadze (1935). The concentrated HCl method so much used here in the past, when applied to 22 lateritic topsoils only gave 65% of the total

phosphorus obtained by the new method. This difference may be largely due to an incomplete dissolving action of HCl on "organic" phosphorus. The ondensed results obtained are given below :—

	Lateritic Alteration		Clay Alteration	
	Topsoils	Subsoils (up to 4 ft)	Topsoils	Subsoils (up to 3 ft.)
Samples examined . .	47	30	7	3
Mgrs Total P_2O_5 % gr. dry soil (range) ...	750 mgr. to 150 „	260 mgr. to 88 „	696 mgr. to 178 „	139 mgr. to 121 „

(f) *Available Phosphorus extracted by hot 1% Potassium carbonate ;*—This method evolved by Whitney and Gardener (1936) is totally different in principle from the more favoured methods, as it uses a dilute alkaline solution for extraction instead of the dilute acids of the citric or Truog methods. It has many affinities with the more elaborate method of determining available phosphorus in the "matière noire" of Grandeau.

These "humo-phosphates (?)" had not previously been studied in Mauritius soils and the results obtained may shed new light on the debated phosphate question : Can the Potassium carbonate-soluble-phosphorus, for instance, be taken as "fixed" or unavailable or is it possible for it to become gradually available? It is probable that such humo-phosphates represent an important stage in the phosphorus cycle and under tropical conditions of rapid mineralisation (well aerated lateritic soils) may constitute the dynamic store of phosphorus in the soil. This method gave the following results :—

	Lateritic Alteration		Clay Alteration	
	Top Soils	Subsoils (up to 4 ft)	Top Soils	Subsoils (up to 3 ft.)
Samples examined . .	47	30	7	3
Mgrs "available" P_2O_5% gr. dry soil (range)	132 mgr. to 6 „	40 mgr. to 1 „	179 mgr. 8 „	26 mgr. to 6 „

3. Phosphate Studies

Work on this subject carried out during the year allow for the following conclusions :—

(*a*) Carelessly cultivated top soils and all subsoils are comparativoly poor in total phosphorus and generally contain less than 200 mgr. total P_2O_5% grm dry soil.

(*b*) The surface accumulation of phosphorus in some well cultivated top soils (up to 750 mgr total P_2O_5 % grm dry soil) is artificial and is mainly due to large applications of phosphorus-rich fertilisers and to the continuous restitution of factory residues for many decades.

(*c*) Soil reaction or lime content is an important indirect factor in the availability of soil phosphorus. The following table shows that "available" P_2O_5 by the new Potassium Carbonate Method is largely dependent on the total phosphorus reserve of soils and is also influenced by soil reaction. Soils of equal total P_2O_5 content show more available P_2O_5 when their reaction is above pH 6.0.

The Table refers to 47 top soils and 30 subsoils (up to 4 ft.) of the lateritic type; the results are given as percentage occurrence of the samples examined in each group.

Total P_2O_5 % grm dry soil

"Available" P_2O_5 (by Potassium Carbonate Method) % grm dry soil.	< 200 mgrs P_2O_5		200—400 mgrs P_2O_5		> 400 mgr P_2O_5	
	<pH 6.0	>pH 6.0	<pH 6.0	>pH 6.0	<pH 6.0	>pH 6.0
<20 mgr P_2O_5	100	52	38	25		
20–40 mgr P_2O_5		48	62	44	70	8
>40 mgr P_2O_5				31	30	92
	100	100	100	100	100	100

(*d*) For lateritic soils, available P_2O_5 by Potassium Carbonate Method is roughly 10 times the available P_2O_5 by Citric or Truog Method. In this connection, the findings of Hilgard on two ferruginous Hawaiian soils are confirmed (see "Soils" by Hilgard—New York, 1919, p. 357).

(*e*) For soils of the clay alteration, especially the more neutral samples, the "available" P_2O_5 by alkaline extraction is not very different from results by acid extraction.

(*f*) The following table gives a provisional key of interpretation of soil analyses and phosphate needs, being based, in addition to our general experience of the subject, on a small scale comparison between soil analyses and results of six field trials with sugar canes and five Winogradsky azotobacter tests.

LATERITIC SOILS CULTIVATED IN SUGAR CANE.

(mgr P_2O_5 % grm dry soil)

Need for phosphatic fertilisers	Soil Reaction	Total P_2O_5	Potassium carbonate sol. P_2O_5	Truog soluble P_2O_5
Large	<pH 6.0	<200 mgr	<20mgr	<2 mgr
Moderate and variable ...	...	200 to 400 mgr	20 to 40 mgr	2–4 mgr
Nil (exclusive of restitution)	...	>100 mgr	>40 mgr	>4 mgr

4. Exchangeable Bases

Extensive data on the nature of exchangeable bases contained in both Lateritic and Clay types of soils through direct analysis of exchangeable Cao, MgO, K_2O and Na_2O have been obtained. The range of exchangeable bases found in Lateritic and clay soils, respectively, are given in the following tables.

Lateritic Alteration

	Top Soils	Subsoils (up to 4 ft.)
Samples examined	23	20
mgr Exchangeable CaO	784 mgr CaO	194 mgr CaO
% grm dry soil	to	to
(range)	29 ,,	11 ,,
mgr Exchangeable MgO	165 mgr MgO	50 mgr MgO
% grm dry soil	to	to
(range)	7 ,,	3 ,,
mgr Exchangeable K_2O	72 mgr K_2O	30 mgr K_2O
% grm dry soil	to	to
(range)	3 ,,	1 ,,

Clay Alteration

	Top Soils	Subsoils (up to 3 ft.)
Samples examined	4	2
mgr Exchangeable CaO	672 mgr CaO	401 mgr CaO
% grm dry soil	to	to
(range)	199 ,,	391 ,,
mgr Exchangeable MgO	602 mgr MgO	907 mgr MgO
% grm dry soil	to	to
(range)	174 ,,	792 ,,
mgr Exchangeable K_2O	75 mgr K_2O	9 mgr K_2O
% grm dry soil	to	to
(range)	2 ,,	1 ,,
mgr Exchangeable Na_2O	2 mgr Na_2O	48 mgr Na_2O
% grm dry soil	to	to
(range)	1 ,,	5 ,,

The correlation coefficients between the various exchangeable bases for the 43 lateritic samples examined are :—

CaO and MgO	R = + 0.91
CaO and K_2O	R = + 0.87
MgO and K_2O	R = + 0.80

These high coefficients clearly show that in the lateritic soils, all three bases are retained or leached to a comparatively similar degree. It should be pointed out, however, that the data refer only to the first 3 or 4 feet layer of the soils. This constitutes, as will be shown later, a single deep A horizon

The average relative proportions of exchangeable bases have been worked out for the 43 lateritic samples :

$$(CaO + MgO + K_2O) = 100 \text{ milliequivalents}$$

Exch. CaO	Exch. MgO	Exch. K_2O
73.5%	23.0%	3.5%

From close inspection of the data, it is not possible to find any systematic change in the relative proportions of the different exchangeable bases in the heavily leached, or in the slightly leached, lateritic soils, though the absolute amounts of bases vary enormously as seen in the annexed tables. The above figures are, therefore, quite characteristic.

For soils of the clay alteration, however, the relative proportions of exchangeable bases varies, there is more magnesium and less calcium with increasing depth.

This study of the Molecular CaO: MgO ratio fully illustrates this difference.

	Lateritic Alteration		Clay Alteration	
	Top Soils	Subsoils (up to 4 ft.)	Top Soils	Subsoils (up to 3 ft.)
Average Mol. $\frac{\text{exch. CaO}}{\text{exch. MgO}}$ ratio ...	3.4	3.0	1.2	0.4

On the related question of *Magnesium deficiency* which attracts much interest, the following conclusions have been reached.

(*a*) The true laterites and, in particular, the "terres franches" of the wettest districts which have been leached of the greater part of their Magnesium are the only soils that could possibly respond to Magnesium fertilisation. It must be stated, however, that such soils are inferior in quality and poor in all other plant food.

(*b*) Some undrained clay soils may contain, on the other hand, too much exchangeable magnesium, resulting in a low $\frac{CaO}{MgO}$ ratio detrimental both to the nutrition of plants and to physical condition of the soil.

(*c*) An abnormally high exchangeable magnesium content is one of the best indications of defective drainage conditions.

(*d*) In considering the possibility of Magnesium deficiency, it should not be overlooked that the basic volcanic rocks of Mauritius are very rich in Magnesium, and consequently, the presence of some stones or gravel may easily constitute a sufficient source of Magnesium for plants.

5. Relative change of Soil Composition with Depth

This study is based on analytical data of cultivated Lateritic soils of the mature "terre franche" type, the samples being collected at various depths up to 3 feet. These do not constitute the complete profiles required for pedological studies as the unaltered parent rock (basaltic rocks) was not reached but the soils chosen (seven in number) are fairly representative of the sugar cane area. For each series of data, the index 100 has been given to the first foot and comparative indices were assigned to the corresponding 2nd and 3rd foot.

The following are the mean comparative indices obtained :—

	Depth 0—12"	Depth 12"—24"	Depth 24"—36"
Intensity of Lateritic decomposition (as shown by combined water content) .	100	103	103
Acidity pH value	100	101	100
Total organic matter	100	45	23
Exchangeable calcium	100	50	51
Exchangeable magnesium ...	100	58	55
Exchangeable potassium ..	100	32	32
" *Available phosphorus*" ... (potassium carbonate method)	100	23	18

The cultivated, mature or " terre franche," lateritic soil type show that :—

(*a*) There is no change in the major soil constituents ($SiO_2 - Al_2O_3 - Fe_2O_3 - H_2O+$) with depth, up to 3 feet. The distinction made in practice between top or arable soil and subsoil is based only on agronomic considerations and chiefly involves differences in organic matter and nutrient contents. In actual fact, the first 3 or 4 feet of these soils constitute a single thick A horizon of an eluvial (residual) nature.

(*b*) The greater comparative richness of the top layers is a direct result of accumulation of plant residues at the surface, this accumulation being artificially exaggerated by intensive sugar cane culture as well as continuous fertiliser applications.

(*c*) All efforts should be directed towards the deepening of the so called arable soil since all local lateritic subsoils are comparatively poor and need fertilization.

(*d*) Of all soil nutrients, Phosphates are those that decrease most rapidly with depth. It follows that the most urgent chemical amelioration should consist in large and deep phosphate applications in the bottom of the holes made for planting canes.

(*e*) The arable or top soil is undoubtedly the most important layer from the nutritional point of view.

(*f*) Great care as to depth of sampling should be exercised when different soils are compared for organic matter or nutrient contents.

6. Detailed Soil Surveys of Sugar Estates

The demand for these surveys is increasing and during the year, analysis of collected soil samples were made by the factory chemists at the Agricultural College Laboratory under constant supervision so as to ensure the necessary uniformity in the data.

The samples, usually top soils, were analysed for degree of laterisation, organic matter, nitrogen, pH value, available P_2O_5 and exchangeable Potassium. The work done is summarized below.

St. Antoine Estate—Mr. G. Mackie analysed 26 top soils.

Queen Victoria and Constance La Gaiété Estates.—Mr. G. G. Ducray analysed 27 top soils.

Beau Champ Estate and Annexes.—Mr. G. Masson analysed 35 top soils and 3 "profiles".

Rose Belle Estate.—Mr. H. Lalouette analysed 24 top soils.

On the basis of these detailed soil surveys, tentative recommendations for fertilisation were made. In addition, these surveys will be very useful in locating future field experiments.

7. Pot Experiment with Magnesium Fertilisers

The soil for this pot experiment was a true laterite from Belle Rive (Highlands). It had a pH value of 6.0 and contained 262 mgr exchangeable CaO and 17 mgr exchangeable MgO% grm dry soil. This comparatively high CaO content suggests that it may in the past have received some lime or coral dressing. Maize was the indicator plant used, each treatment being repeated four times in wooden boxes containing 15 kgs of soil.

The basal treatment (N.P.K.) was very high and consisted on an acre basis of :—

250 kgs N { 175 kgs Ammoniacal Nitrogen from Supernicifos
75 kgs Nitric nitrogen from nitrate of soda.

500 kgs P_2O_5 in the water soluble form from Supernicifos.
500 kgs K_2O from sulphate of potash.

Results of the Pot Experiment

	Treatment (on acre basis)	Relative Yield of green plants before flowering
NPK	+0	100
„	+5 tons $CaCO_3$	78
„	+4 tons $MgCO_3$	86
	+2.5 tons $CaCO_3$ + 2 tons $MgCO_3$ ...	87
„	+4.3 tons $CaSO_4.2H_2O$	89
„	+6 tons $MgSO_4.7H_2O$	112
„	+5 tons $CaCO_3$ + 6 tons $MgSO_4.7H_2O$	97

Conclusions.—Magnesium sulphate seems to have slightly increased the maize yields. The high potassium fertilisation (500 kg K_2O per acre) may, however, have induced the magnesium deficiency.

8. Foliar Diagnosis

This physiological method originated by Lagatu and Maume consists in determining at intervals preferably, the chemical composition of leaves of a predetermined rank. The third leaf blade from the top was selected from young virgin BH.10 (12) canes from three manurial trials. For each treatment, two separate samples were collected and analysed by the analytical methods given by A. Demolon in "La croissance des végétaux."

Reduit Trial Bio. 5

BH. 10 (12) planted 5.1.36. Leaves sampled on 30.6.36

PLOTS	in terms of % dry matter						Physiological Ratios		
	Total Ash	N	P_2O_5	K_2O	CaO	MgO	$\frac{N}{P_2O_5}$	$\frac{N}{K_2O}$	$\frac{K_2O}{P_2O_5}$
N.P.K. ...	5.58	1.53	0.36	1.19	0.35	0.31	4.3	1.3	3.3
N.K. ...	5.76	1.53	0.32	1.44	0.26	0.26	4.8	1.1	4.5
N.P. ...	5.21	1.56	0.35	0.92	0.29	0.35	4.5	1.7	2.6

Total fertilisers per acre applied at planting and on 26.3.36 :—

27 kgs N { 20 kgs Am. Nitrogen as sulphate of ammonia.
7 kgs nitric Nitrogen as Nitrate of soda.

75 kgs P_2O_5 { 50 kgs insoluble P_2O_5 as guano phosphaté.
25 kgs water soluble P_2O_5 as superphosphate.

75 kgs K_2O as sulphate of potash.

A little farmyard manure applied at planting.

Queen Victoria Trial Bio. 7

BH. 10 (12) planted on 16.3.36. Leaves sampled on 8.7.36

PLOTS	in terms of % dry matter				Physiological ratios		
	Total Ash	N	P_2O_5	K_2O	$\frac{N}{P_2O_5}$	$\frac{N}{K_2O}$	$\frac{K_2O}{P_2O_5}$
N.P.K. ...	6.78	1.71	0.43	1.12	4.0	1.5	2.6
N.P. ...	6.60	1.68	0.41	1.07	4.1	1.6	2.6

Total soluble fertilisers applied per acre at planting and on 23.4.36 :—

N.P.K. plots :—366 kgs C.C.F. No. 5 (8% N. 21.5% P_2O_5, 16% K_2O)

N.P. plots :—186 kgs supernicifos (13.5% N, 42% P_2O_5) 25 kgs nitrate of Potash.

All plots received 3 tons molasses and 5 tons farm yard manure at planting

Bel Ombre Trial Bio. 8

BH. 10 (12) planted 27.3.36. Leaves sampled 22.7.36

PLOTS	in terms of % dry matter					Physiological ratios		
	Total Ash	N	P_2O_5	K_2O	CaO	$\frac{N}{P_2O_5}$	$\frac{N}{K_2O}$	$\frac{K_2O}{P_2O_5}$
NK (no phosphates)	7.99	1.92	0.49	1.50	0.34	3.9	1.3	3.1
NPK (guano phosphate)	7.96	1.84	0.46	1.49	0.33	4.0	1.2	3.2
NPK (precipitated phosphate)	8.37	1.87	0.47	1.65	0.35	4.0	1.1	3.5
NPK (supernicifos)	8.19	1.84	0.48	1.49	0.36	3.8	1.2	3.1

Total fertilisers applied per acre at planting and on 12.5.36 :—

N K. (to all plots) { 23 kgs N { 16 kgs am. nitrogen from sulf. of am. or supernicifos. / 7 kgs nit. nitrogen from nitrate of potash ; 20 kgs K_2O from nitrate of potash }

guano phosphaté—50 kgs insoluble P_2O_5.
precipitated phosphate—50 kgs am. citrate soluble P_2O_5.
supernicifos—50 kgs water soluble P_2O_5.

The method may be used as a control in Manurial trials in order to obtain some information as to whether the fertilisers applied have actually entered into the cane.

In the Réduit trial on a poor soil, assimilation of added P_2O_5 and K_2O has been demonstrated and a case of antagonism between the bases Potassium, Calcium and Magnesium established. In the Queen Victoria and Bel Ombre trials, the foliar diagnosis was not very different for the various treatments. It must be noted, however, that the soils of these trials are in a fair state of fertility.

As a method of determining fertiliser needs, the foliar diagnosis is very attractive in theory; nevertheless its sensitivity may be too high and results may be influenced by other growth factors such as particular climatic conditions. The method could only be used on a practical scale, if ideal or balanced physiological ratios are proved to be associated with highest yields. If such ratios exist for any cane variety, they could be obtained from the foliar diagnosis of a large number of N.P.K. plots in manurial trials.

II. MANURIAL TRIALS

Conditions for cane growth and high sucrose content were exceedingly favourable during the crop year, the rainfall, though somewhat low, being, early and well distributed.

As no consistent difference in cane quality could be found on analysis cane yields will only be given for the various manurial trials.

Mr. A. North Coombes, the Agronomist, supervised the fertiliser applications and reaping of some of the following trials.

1. *Heavy dressings* of chemicals compared to *low dressings at Réduit Border effect.*

Réduit Trial 69.

This trial (variety M.27/16) was reaped this year as 1st ratoons. The yields of cane acre obtained after discarding the two outside rows of the plots and retaining the four central rows are given below for the virgins and 1st ratoons.

	Tons cane/acre	
	VIRGINS 1935	1st RATOONS 1936
"A" plots—low fertilization ...	21.7	21.0
"B" plots—heavy fertilization ...	39.2	35.1

Four times as much of the complete fertiliser (N.P.K.) applied to the "A" plots was applied to the "B" plots.

With such differences in yields between regularly alternating adjacent "A" and "B" plots, a high border effect would be expected. The mean yields in virgin and 1st ratoons of the two outside rows (1 and 6) in terms of the two central rows (3 and 4) are given below.

	"A" Plots Low Fertilization	"B" Plots Heavy Fertilization
Yield of central rows (3 and 4) ...	100	100
Yield of outside rows (1 and 6) ...	113.1	105.5
Significant difference (20 : 1) (Student's pairing method)	11.7	15.5

In spite of a high "error," it is proved that under the conditions of the experiment, the outside rows of the low fertilized plots, adjacent to heavily fertilized plots are definitely heavier yielders than the corresponding inner rows.

In the current year, the canes from the "B" plots (heavy fertilisation) were definitely richer in sucrose and more ripe (contained less glucose) than those from the "A" plots (low fertilisation).

Just as with the virgins, the juices from the "B" plots were poorer (?) in $P_2 0_5$ and richer in $K_2 0$ than the juices from the "A" plots.

2. *Farmyard Manure* plus chemicals compared to *heavy doses of chemicals only*, on virgins.

Two such trials with virgins were harvested and the results given below —

St André Trial 92 POJ. 2378 (irrigated) Treatment per acre	Tons cane/acre	Tons cane/acre	Queen Victoria Trial 89 BH 10 (12) Treatment per acre
15 tons F.Y.M. in one dose plus 7 kgs N, 30 kgs $P_2 0_5$, 25 kgs $K_2 0$	45.8	39.4	*25 tons F.Y.M. in one dose* plus 32 kgs N, 30 kgs $P_2 0$ 24 kgs $K_2 0$
15 tons F.Y.M. in two doses plus 7 kgs N, 30 kgs $P_2 0_5$, 25 kgs $K_2 0$... ...	46.5	41.1	*25 tons F.Y.M. in two doses* plus 32 kgs N, 30 kgs $P_2 0_5$ 24 kgs $K_2 0$
Straight Fertilisers alone... (85 kgs N, 85 kgs $P_2 0_5$, 40 kgs $K_2 0$... ...	47.9	38.0	*Straight Fertilisers* alone (90 kgs N, 65 kgs $P_2 0$, 65 kgs $K_2 0$
Significant difference (20:1) between two different treatments ...	3.6	6.5	Significant difference (20:1) between two different treatments

Though no difference is statistically significant, yields are in favour of heavy fertilisers at St André, while at Queen Victoria the reverse is shown.

3. *Straight Fertilisers* compared to *Concentrated Fertilisers.* The results of two such trials are given in the following table :—

St André Trial 92 POJ 2878 (irrigated) Treatment per acre	Tons cane/acre	Tons cane/acre	Queen Victoria Trial 91 BH 10 (12) Treatment per acre
Straight Fertilisers (85 kgs N, 85 kgs P_2O_5) 40 kgs K_2O) ...	47.9	40.4	*Straight Fertilisers* (40 kgs N, 80 kgs P_2O_5, 60 kgs K_2O
Concentrated Fertiliser (C.C.F.) 85 kgs N, 105 kgs P_2O_5, 40 K_2O ...	49.5	37.4	*Concentrated Fertiliser* (C.C.F.) 40 kgs N, 80 kgs. P_2O_5, 60 kgs K_2O
Significant difference (20:1)	3.6	1.5	Significant difference (20:1).

The trial at St. André gave a higher yield with concentrated fertilisers, while at Queen Victoria, straight fertilisers were superior.

4. *Form of Phosphate Trial.* 2nd ratoons M. 27/16–11 months old.

RICH FUND S. E.

Treatment kgs per acre				Yield tons per acre
N	K_2O	P_2O_5		
30	20	0	(no phosphates)	30.5
30	20	50	(insoluble *guano phosphaté*) ...	30.9
30	20	50	(soluble *super nicifos*) ...	30.6
Significant difference (20:1) between two treatments ...				2.8

There is no response to phosphate fertilisation, and in the absence of positive action of phosphates on yield, this trial is not suited for testing the different merits of guano phosphate and supernicifos.

5. *Nitrogen and potash trial in presence or absence of F. Y. M.* This trial with B.H. 10 (12), is now completed and has been reaped in virgins (1934), 1st ratoons (1935) and 2nd ratoons (1936.)

BEL AIR, ST. FÉLIX S. E. TRIAL 66

Mean Treatment per crop kgs / acre			Tons cane/acre 10 tons F.Y.M. to virgins only				No F.Y.M.				
N	P_2O_5	K_2O	Virgins	1st rat.	2nd rat.	Mean	Virgins	1st rat.	2nd rat.	Mean	
40	25	35	21.2	34.2	33.4	29.5	20.4	35.4	31.4	29.1	Complete Fertiliser
0	25	35	19.2	34.2	30.3	27.9	17.7	34.0	25.5	25.7	No nitrogen
40	25	0	21.0	35.1	34.8	30.3	20.1	35.6	31.5	29.1	No potash
Significant difference (20:1) between two treatments		...	...	...	...	0.9	...	...	...	4.0	

Conclusions.—(a) 12 tons F.Y.M. have very slightly inceased mean yields.

(b) Nitrogen fertilisers have given a response especially in the absence of F. Y. M.

(c) The use of potash has not resulted in increased yields. The soil contained, at the commencement of the experiment, 42 mgr enchangeable K_2O% grm dry soil.

6. *Nitrogen, potash and phosphate trial at Benares S.E.* This trial with White Tanna canes has now been reaped in virgins (1934) 1st ratoons (1935) and 2nd ratoons (1936).

The whole field in virgins, received 20 tons F.Y.M. and 150 kgs. guano phosphate per acre.

BENARES S E. TRIAL 53

Mean treatment per crop kgs / acre			Tons cane/acre				
N	P_2O_5	K_2O	Virgins	1st ratoons	2nd ratoons	Mean	
0	0	0	21.6	28.0	24.7	24.8	No chemicals
20	0	0	25.3	30.5	29.3	28.2	Nitrogen
0	0	30	21.6	27.1	23.0	23.9	Potash
20	0	30	27.1	32.3	30.6	30.0	Nitrogen and Potash
40	0	0	27.8	31.3	32.7	30.2	Two Nitrogen
0	0	60	23.0	29 8	25.9	26.2	Two Potash
40	0	60	27.2	31.7	30.5	29.8	Two Nitrogsn and two Potash
40	25	60	29.7	33.1	36.6	33.1	Complete fertiliser
Significant difference (20:1) between two treatments		...	2,3	2,8	4.1	2.3	

Conclusions.—(a) In spite of the application of 20 tons of F.Y.M. to virgins and 150 kgs guano phosphaté, mean increases of 8.3 tons of cane have been obtained from a complete fertiliser

(b) Nitrogen fertilisers have been efficient.

(c) There is a response to phosphates. The soil contained : 376 mgr total P_2O_5.37 mgr. "available" P_2O_5 (Potassium Carbonate Metho1) and 2.2 mgr Truog soluble P_2O_5—% grm dry soil.

(d) There is no response to Potash. The soil contained 34 mgrs exchangeable K_20% grm dry soil.

7. *Other N.P.K. Trials at Grande Savanne.* In addition to the above mentioned trials, other N.P.K. trials have been reaped, as they are not yet completed full details are not given.

The following is a condensed table of all trials reaped in 1936 at Grande Savanne.

Estates	Category and variety of canes	Complete Fertiliser	Tons cane/acre Diffce. between comp. fertiliser and : No Nitrogen	No Phosphates	No Potash
Bel Air, St Félix	1st ratoons				
Trial 70	BH 10 (12)	36.5	− 1.4	−1.7	−3.3
Beau Bois Trial 72	do	34.8	−4.1	−3.6	−0.5
BénarèsTrial 71	do	35.6	− 2.7	−1 0	+0.1
Bel Air, St Félix	2nd ratoons				
Trial 66	BH 10 (12)	33.4	−3.2	...	+1.4
Bel Air, St Félix					
Trial 66	do	31.4	−5.9	...	−0.1
Bénarès	2nd ratoons				
Trial 53	White Tanna	36.6	...	−6.1	...
Bénarès Trial 53	do	30.5	−4.6	...	+2.2

Conclusions.—(a) Nitrogen and Phosphate fertilisers have always been effective.

(b) Potash has only been effective in one case out of six.

January, 1937.

PIERRE HALAIS,
Scientific Assistant, (for the Biochemist).

PART III — RESEARCH BOTANY

By

H. Evans, Ph. D.

INTRODUCTION

As in previous years the Physiological Division was concerned mainly with root investigations, including, on the one hand, fundamental investigations of root problems, and on the other, field experiments to test the practical applications formulated as a result of previous root work. In addition, attention has been paid to subsidiary problems and small scale experiments carried out in an attempt to elucidate some of these problems. It is only possible in this report to describe briefly the work accomplished and the results obtained, more detailed accounts of some aspects of the work may be found in Bulletins No. 10, 12 and 14 of this Station, and in further Bulletins which will be published in the future.

ROOT INVESTIGATIONS

In the past, attention has mainly been devoted to the distribution of roots in the soil, to the morphological features of the major root types found in Sugarcane, and to the development of the root-system in the most important commercial varieties from the time of planting the cutting to maturity. Quantitative observations on root development were also carried out on one variety viz White Tanna, by weighing the roots of 25 plants at monthly intervals.

These investigations have been of importance in indicating how varieties differ in root development, the range of varieties being exceptionally large (50). Considerable differences were found between varieties, and some were selected for Phytalus areas on the basis of prolific and deeply seated root-systems. Data available up to the present indicate that selection on the basis of vigour of root development was on the whole sound, but there were some notable exceptions, e.g. POJ. 2878 which did not have an outstanding root-system appeared to be very resistant to Phytalus, whereas BH.10 (12) which has a more extensive root-system under similar growth conditions was more susceptible to Phytalus injury. In an effort to obtain more quantitative data on the efficiency of root-systems, a method was worked out for the determination of the actual surface area engaged in absorption. During the year improvements have been made in the method originally worked out, and the method has now reached a stage where it is as near perfection as can reasonably be expected.

METHOD OF DETERMINING THE ABSORBING SURFACE OF SUGAR CANE ROOT SYSTEMS

A sector of the root system generally consisting of 1/3 to 1/2 of the complete root system is examined. Taking the centre of the stool as the apex of the sector, arcs are drawn of radius 1′, 2′, 3′, etc. to a maximum distance of 9 feet. The soil and roots in each of these areas is carefully removed, firstly to one foot of depth until the whole sector has been completed. The same procedure is then followed for the remaining foot layers to a depth of 6 feet. Knowing the angle of the sector, the roots in the whole system can then be evaluated. On the soil and roots which have been excavated from these zones,

the process of extracting the roots from the soil is then begun. At the beginning this was done by hand, but water extraction was later found to be much quicker and more efficient.

A large steel box was made (the steel being obtained from empty oil drums of 50 gallons capacity) standing on four legs—two legs being 6″ shorter than the remaining two legs, thus giving a slope to the box. The dimensions of the box as finally chosen (following the use of several smaller ones) was 6 feet long by 4 feet wide by 1½ feet deep. A large quantity of soil can be dealt with in such a box. At the lower side of the box, 3 large circular holes were made, closed by rubber stoppers. A jet of water at considerable pressure is played on the soil breaking up the lumps and churning up the soil, until the water is about a foot deep in the box. The roots, which are thus freed from the soil, either float or remain in suspension in the water. The large rubber corks are then removed one by one, the water and roots which escape passing through a fine mesh sieve. Five such washings to each filling of soil served to extract all the roots from the soil mass, even the most delicate fibrous roots which could not be extracted by hand. Mixed up with the roots, there is a considerable amount of foreign matter (such as lumps of charcoal and other vegetable matter) which has later to be removed. An apparatus was devised which does this very expeditiously. A sample of the roots is, however, previously taken for fixing and imbedding. The samples are taken as follows :—Small bundles of roots including all types are picked out, and a length of 2 cms. or so cut out of the bundle. These 2 cm. lengths of roots are immediately placed in 70% alcohol in specimen tubes, several such samples are taken from each root system, generally from 0–1 ft., 3–4 ft. and 5–6 ft from the stool at depths of 0–1 ft., 2–3 ft. and 5–6 ft. Such a composite sample is a representative sample of the whole root-system.

The separation of foreign matter from the roots is effected as follows :— The roots are air-dried, and all the major roots picked out by hand—the fibrous roots and foreign matter are placed in a long glass tube 1½ metres long and about 1½ inches in diameter. This tube is fitted with a cork and glass tubing at the lower end and a piece of muslin is tied around the upper end. A current of air from a blowpipe is sent in through the glass tubing at the base. By this means the fine roots are blown higher up the tube than the foreign matter which generally consists of lumps which fall to the bottom of the tube when the air blast is stopped. A complete separation of the roots and foreign matter is thus effected.

All the roots are then graded into four classes according to diameter ; Class I Fibrous roots ; Class II thin, mainly secondary roots ; Class III somewhat thick, mainly primary roots or stout secondaries ; Class IV very thick roots, mainly buttress roots. The diameter classes are as follows :— Class I, about 0.2 mms ; Class II, 0.5 to 0.7 mms ; Class III, 0.7 to 2.5 mms ; Class IV, over 2.5 mms. The length of the roots of each class is then determined, Classes II to IV are measured with an ordinary rule. For Class I it is obvious that direct measurement is impossible and a special method was therefore devised for the measurement of these roots. The mean diameter of the Class I roots is determined under the microscope using a micrometer scale. By arranging them serially on a glass slide the diameter of 200 or more can be determined in a few minutes. When all the fibrous roots have been taken off the main roots, they are placed in an empty, accurately graduated, flask.

From a known volume of paraffin oil in another graduated flask, sufficient is poured into the flask containing the roots to bring the volume to the mark. What is left represents the volume of the fibrous roots.

It was previously found that paraffin oil was the only one of several fluids tried which did not cause a swelling or contraction of the roots in the time necessary to determine the volume. An accurate value of the total volume of fibrous roots is thus obtained, and knowing the mean diameter, the total length of fibrous roots is obtained assuming them to be cylindrical, which they practically are.

By this technique the total length of the four classes of roots in each zone is obtained. The next procedure is to determine the density of root hairs on the roots. The samples in 70% alcohol are washed and brought through the usual cytological stages to xylol and imbedded in paraffin. Sections of 1/10mm thickness are cut by a hand-microtome, 3 or 4 sections are taken of each root and about 60 of the major roots and a hundred or more of the fibrous roots are sectioned for each system. Root hair counts are made on the sections, and the mean number of roots hairs per 1/10mm. for each of the classes of roots determined. Measurements of the length and mean diameter of the root hairs are made on fresh roots, to avoid any possibility of contraction of the hairs in imbedding.

If the system is young and contains an appreciable percentage of white roots (the epidermis of which is capable of direct absorption), the white roots are separated and their length measured. The mean surface area of a root hair is calculated from determinations of length and diameter; and from the number of root hairs per section, the root hair surface per unit length for the different classes of roots is calculated and eventually the total root hair surface of the system. The direct surface area of white roots is added to this figure if it is of any consequence. Thus a figure which is a close approximation to the surface engaged in absorption is arrived at.

THE ABSORBING SURFACE OF POJ. 2878, BH. 10 (12) AND WHITE TANNA AT MATURITY

The first determinations were made on stools of POJ.2878, BH.10 (12) and White Tanna which had been planted specially for root studies and whose root development had already been followed at intervals. They were mature stools at the time of examination. The results of this investigation are, at the moment, in the press and will shorly be published as Bulletin No. 12 of the Station.

The very important result which appeared from this work was that the extent of the absorbing surface is not, of necessity, correlated with the length or number of roots, as shown in the following table:—

	POJ.2878	BH. 10 (12)	White Tanna
Total length of all classes of roots (cms.)	810,911	1,733,376	1,387,712
Absorbing surface in square cms.	124,511	75,178	14,550

It does not, of course, follow that these considerable differences in root-hair surface existed during the whole life-history of the plants. In fact, it is more likely that White Tanna and BH. 10 (12) with their longer length of roots may have had a larger absorbing surface than POJ. 2878 at earlier stages, but in canes of 12–15 months old, in this environment, POJ. 2878 was very definitely superior to the other varieties.

INHERITANCE OF ROOT CHARACTERS IN SEEDLINGS

Special plantings were made of D. 109, POJ. 2364 and of seedlings from the cross D. 109 × POJ.2364, in order to determine whether the main characters of the parents were transmitted to the offspring. The issue was complicated by the fact that the seedlings show a measure of hybrid vigour which is not maintained in subsequent plantings. The work is therefore being repeated using cuttings (single eye setts) from each of the stools previously examined.

In this work (which is fully described in Bull. No. 14, Sugarcane Research Station series, now in the press) the study by the direct examination method showed a closer similarity between the root system of the seedlings and that of the female parent (POJ. 2364) rather than with that of the male parent D. 109. As regards root development, the seedlings were generally the most vigorous particularly in the finer roots. The degree of branching to form fibrous roots was markedly greater in the seedlings and in POJ.2364 than in D.109. The results of the determination of the absorbing surface, however, was markedly in favour of D.109 as is shown in the following table:—

	POJ. 2364	Seedling	D. 109
Total length of roots (cms) ...	286,681	292,511	245,099
Extent of absorbing surface (sq. cms)	10,055	17,986	37,944

This was due to a markedly greater density of root hairs on the roots of D. 109. It is proposed to follow the development of the absorbing surface in these three types of cane, and plantings for this purpose have already been made.

TESTING CANES FOR DROUGHT RESISTANCE

An attempt was made to devise a simple and efficient way of determining drought resistance. There is reason to suppose that drought resistance ultimately depends on the extent of the absorbing surface, or at least on the relationship between the absorbing surface and the transpiring surface, a figure which might be expressed as a ratio, $\frac{\text{Leaf Surface}}{\text{Root hair Surface}}$

A period of drought inhibits the entrance of water into the absorbing tissues, and the larger the absorbing surface, the greater the quantity of water which can enter into the plant. A similar effect to that of drought can be introduced by decreasing the effective absorbing surface. (This is what actually takes place in a period of drought—the roots in the superficial soil layers being rendered inactive). The technique adopted for promoting this artificial drought effect was as follows. A circle of 6″ radius was marked taking the centre of the stool as the centre of the circle. A trench was dug outside this circle, 2 feet wide, and 1 ft deep : all the roots passing outwards in the first foot of soil being thus cut off. The stools were effectively propped up, and examined at intervals. Growth measurements of the canes following the treatment, as compared to untreated controls, were also carried out. Such experiments were carried out only on those varieties whose absorbing surface had already been determined, viz, in the first series, POJ. 2878, BH.10 (12) and White Tanna ; in the second series POJ. 2364, D.109 and seedlings of this cross. The results were very marked.

In the first series White Tanna eventually died, BH.10 (12) lost a large proportion of its leaf surface by yellowing followed by auto-defoliation

while POJ. 2878 only lost a few leaves through auto-defoliation. Their behaviour was therefore in complete agreement with the order of their absorbing surfaces found.

In the second series, variability was shown in the seedlings only, this being expected since the seedling used for the determination of absorbing surface was a potentially different variety to that used for the investigation of behaviour under induced drought. Of the three, D. 109 was by far the most resistant to the treatment, showing hardly any signs of yellowing, and very little defoliation occurred. POJ.2364 was second, showing marked yellowing and extensive defoliation, and the seedling was almost completely killed, the spindle only, remaining green.

The following growth figures show the superiority of D. 109 in resisting this root pruning treatment :

Growth rate of Sugarcane varieties under conditions of induced drought

	POJ. 2364	Seedling POJ. 2364 × D. 109	D. 109
1st Series	0.69 cms	0.41 cms	1 22 cms
2nd Series	0.36 cms	0.44 cms	2.00 cms
Controls	3.80 cms	...	4.60 cms

(S.E. of measurements :—0.40 cms)

No significant growth increment had taken place in POJ.2364 or the seedling, whereas the growth increment in D.109 was fully significant. This behaviour is in accordance with what might be expected from the absorbing surface of these varieties and is in complete agreement with the known resistance of D.109 in the dry districts. Although further work is necessary to establish the results obtained, it certainly appears that a simple technique as described above may be effectively used to test the resistance or susceptibility of sugar cane varieties to periods of prolonged drought.

There is little doubt that resistance to Phytalus also is to a large degree associated with the extent of the absorbing surface, since those varieties which have an extensive absorbing surface would be able to lose a greater proportion of their root system before the supply of water to the plant became seriously limited by the deficiency of absorbing tissue. Some data on the rate of entrance of water into the absorbing tissue of the roots have been obtained, and the relation between rate of entrance of water and the rate of loss through transpiration determined. The results of this work have been published in " La Revue Agricole de l'Ile Maurice " (Oct-Nov. 1936). It was found that the absorbing tissue of the sugarcane could supply 361 ccs. of water per square metre per hour, if the water supply in the soil is not limiting. Nutman found a rate of only 2.5 ccs. per square metre per hour for Coffee. The sugarcane root system can therefore supply water, per unit area, at 145 times the rate that the coffee root system can do so. The absorbing surface of coffee is, however, far greater than that of the sugarcane. The sugarcane absorbing system had a potential water-supplying power equivalent to 3 times the maximum rate of transpiration obtained. One sugarcane stool having 12 large canes would transpire on a warm day roughly 7 litres of water (this being the average value actually obtained). To provide for this 1 square metre of absorbing surface could supply 9 litres of water per day, providing the supply in the soil is not limiting.

No significant difference in the osmotic pressure of the root fluids was obtained between POJ.2878, BH.10 (12) and White Tanna, so that it may be assumed that the efficiency of the absorbing tissue must be about equal, for equal areas, in the three varieties. It is obvious, therefore, that the greater the margin between the actual absorbing surface of a sugarcane variety, and that which is actually essential, the greater will be its chances of survival under the depredations of a root-eating pest such as Phytalus.

In the writer's opinion there is little doubt that the comparative success of POJ.2878 on Phytalus lands is due to its extensive absorbing surface *at the time when the larvae are actively feeding.*

ROOT DEVELOPMENT ON DIFFERENT SOIL TYPES

It is obvious that the actual absorbing surface of sugar cane is not only dependent upon the variety, but also upon the growth conditions of the environment, so that even in selecting for Phytalus resistance it is essential to have a variety which normally grows well in that particular environment assuming that Phytalus is absent.

The way in which soil and climatic conditions affect root development, both as regards distribution of roots and extent of absorbing surface is at present being investigated. The examinations at 3 months, 6 months and 9 months have up to date been concluded. The results will be treated in detail in a future bulletin. It may be remarked in passing that, in Mauritius, climate appears to have a far greater effect on the root system, at least in the early stages, than soil, soil differences being of course associated with these climatic differences. In the wet districts the roots are very superficial and root-hair density is low. In the dry districts the roots are very deeply seated and root-hair densities are high.

Differences are also apparent in the manner in which the canes adapt themselves to different growth conditions, in particular, in the ratio $\frac{\text{Transpiring Surface}}{\text{Absorbing Surface}}$. This ratio is high in the wet districts and low in the dry districts. Differences in the ratio also exist between different varieties in the same environment. A low ratio is an attribute to the plant in its water-economy.

TOXICITY OF SUGAR CANE ROOTS

This problem was brought to the notice of the writer by certain planters from the drier parts of the island. On some estates, the canes have to be planted between interline walls consisting of stones removed from the field when the land was first brought under cultivation. It is common knowledge that when a field is uprooted, and the new virgin crop planted in the line previously occupied by the canes, that yields drop considerably. As a result the planters move the walls to the space previously occupied by the row of canes, and replant in the interline from whence the walls were moved. This procedure entails a considerable expenditure. It occurred to the writer that a possible explanation of the decreased yields might be found in the toxicity of decaying sugarcane roots to the newly planted crop. Pot experiments were carried out with POJ.2878 and BH.10 (12). Control pots were left untreated, and certain pots were treated with 100, 150 and 200 grs of cut-up sugarcane roots, which were intimately mixed with the soil. The growth of all the treated plants was significantly inferior to the controls, and the decrease in

growth rate increased with the amount of roots added. Growth of one variety was not only decreased by roots of another variety, but also by its own roots. In the case of the smallest dose of roots, the rate of growth became equal to, and even slightly higher than, those of the control plants after 3 months.

It appears, therefore, that the decreased yield when canes are replanted in the same lines is mainly due to the toxic effect produced by the high concentration of decaying roots of previous cane crops. The deterioration in yields could possibly be avoided by one or more of the following treatments :—

1. Intensive cultivation to promote oxidation of the toxic substances and allowing an interval of 3–6 months before replanting.

2. The addition of powdered charcoal, followed by cultivation to promote absorption of the toxic substances.

3. An application of a fairly high dose of fertilisers, (many of which have oxidising properties).

ROOT INVESTIGATIONS ON RATOON CROPS

Work on the determination of the absorbing surface of several important varieties of cane as first ratoons has been commenced. An area of 30 square feet is examined for each variety, the roots being extracted separately from the first and second foot layers. The first examination was carried out 3 months after the harvesting of the virgin crop, and it is proposed to carry out such determinations at 3 monthly intervals. Before the work was commenced five such samples were taken from a row of one variety to determine the degree of variability which might be expected. It is much more difficult to determine the absorbing surface of ratoon crops particularly in the early stages owing to the preponderance of the old virgin roots still present. In the present instance, the ratoon roots were separated from the old virgin roots, but the process of separation is a very tedious one.

All the varieties of which the absorbing surface has been determined, have been planted in multiplication plots at Cote d'Or S.E. where it is proposed to lay out a Phytalus resistance trial on badly infested land in 1937. It will thus be possible to determine whether Phytalus resistance is correlated with the extent of the absorbing surface developed. The varieties to be included in the experiment are :—POJ.2727, POJ.2878, BH.10 (12), Selangor Seedling S.C.12/4, M.196/31, M.108/30, M 5/30, M. 72/31 and M.73/31.

If, as is expected, Phytalus resistance will be shown to depend mainly on the extent of the absorbing surface developed, or on the $\frac{\text{Transpiring Surface}}{\text{Absorbing Surface}}$ ratio, the problem of selecting canes for Phytalus lands will be considerably simplified.

The results of the investigations into the development of the absorbing surface in the varieties of canes examined will be published when the results are complete.

SOME PRACTICAL APPLICATIONS OF THE RESULTS OF PREVIOUSLY CONDUCTED ROOT STUDIES

(1) *Subsoiling.*—The effect of subsoiling in promoting a more deeply seated root-system, with an enhanced absorbing surface, appears to be

beneficial on Phytalus lands on certain estates. Where irrigation is practised, subsoiling, however, is not favoured, as too much water is lost by seepage. It was pointed out in the first instance, that it is under dry conditions, and under conditions of Phytalus attack that subsoiling would be most likely to have beneficial effects.

(*2*) *Methods of application of fertilisers.*—From the results of root-studies alone, it was shown that the methods of fertiliser application frequently practised, might be considerably improved. The bearing of root-studies on problems of fertiliser application was discussed in Bulletin No. 6.

The conclusions drawn from root-studies cannot, in themselves, be taken as conclusive proof that any suggested method is likely to be superior to those in vogue, as it is always possible that certain important factors might have been left out of consideration. The final proof lies in experimentation on a field scale to test the conclusions arrived at.

Two large scale field trials were therefore laid down, one at Labourdonnais S.E. in a very dry part of Mauritius and one at Rose Belle S.E. in a wet part of the Island.

Labourdonnais Experiment : —At Labourdonnais, the soil is rich, and water is generally the limiting factor : consequently it is very seldom that a response to fertilisers is obtained there.

The treatments selected were as follows :—

(*a*) All fertilisers applied at bottom of hole before planting.

(*b*) All Phosphate, 1/3 Potash, plus 1/3 Nitrogen applied at bottom of hole before planting; 2/3 Potash plus 1/3 Nitrogen applied at 3 months over a zone extending from stool to 1 foot into interline on each side and turned in by hoe; remaining 1/3 Nitrogen applied at 6 months uniformly over the interline and turned in. (This is the method that was advocated as a result of previous root studies, vide Bulletin No. 6, Sugarcane Research Station, pp.39–40).

(*c*) All the fertiliser applied 3 months after planting, uniformly over the interline and turned in by cultivation.

(*d*) All fertiliser applied on the stool at 3 months and afterwards covered with soil (commonly used method of application practised on some estates in this part of Mauritius).

(*e*) Controls, not fertilised except basal dressing of 3 tons fumier per acre at planting.

The dosage of fertilisers was as follows :—

	kgs	P_2O_5 kgs	K_2O kgs	N kgs
Guano phosphate	... 300	75	...	...
Nitrate of Potash	... 100	...	40	14
Nitrate of Soda	... 150	...	...	22
Total amount of mixture	.. 550	75	40	36

The trial was laid out in the form of four randomised blocks each containing five plots. The plots were 1/10 acre in area, but after elimination of

border rows between the treatments and around the plots, the effective plot size was reduced to 1/16 acre. The results of the trial are given below :—

	A	B	C	D	E	Gen. Mean	S.E.	Sign. Diffce
Mean Yield (Kgs/plot) ...	305.6	329.1	305.5	291.9	284.6	303.3	6.0	19.0
Per cent. of gen. mean of all plots	100.7	108.5	100.7	96.2	93.8	100	1.98	6.26

S. E. of difference between two means = 8.5 Kgrms

Significant difference between two means = 19.0 Kgrms.

The yields in tons per acre are as follows —

A	B	C	D	E
19.5	21.1	19.5	18.7	18 2

Treatment B was significantly better than all the others, giving an increase of 2.9 tons per acre over no fertiliser. Treatment D, the ordinary method of application in this part of Mauritius gave no significant response over no fertiliser. Thus an experiment to test a fertiliser application where it was applied by method D might have given no response under these conditions, whereas if it had been applied according to method B a significant response would have been obtained.

A similar experiment carried out at Rose Belle will be harvested in 1937. Judging from appearances this experiment will also support the recommendations made on the basis of root studies.

SOME PRACTICAL APPLICATIONS OF THE RESULTS OF THE COURSE OF GROWTH EXPERIMENT

In bulletin No. 7 the course of growth in sugarcane, and accumulation of mineral substances during its life history was described. The writer was struck by the fact that the course of absoption of Nitrogen was continuous almost up to maturity, whereas most planters apply the whole of the Nitrogen in the early stages. Was this late accumulation of Nitrogen merely luxury absorption or could it effect an increased yield ? An experiment was carried out at Ebene S.E. in which the effect of a late application of Nitrogen on the growth and metabolism of the cane was investigated. The results have been published as Bulletin No. 10 (Sugarcane Research Station series). An increase of 8 tons of cane per acre and a decrease of over 50% in the number of arrows (inflorescences) was produced. The concentration of calcium and potash in the juice was not affected by the additional Nitrogen, but the concentration of phosphate was greatly reduced, probably indicating a greater utilization of the phosphorus. The nitrogen cause a greatly increased tillering, and the reduced arrowing reduced the loss of canes by drying out.

A similar large scale experiment occupying 10 acres was carried out at Mon Désert S.E. Moka. The amount of Nitrogen applied was considerably less, but it was applied later (April as compared to February at Ebene S.E.) When applied in April, the Nitrogen failed to reduce arrowing, but nevertheless produced an increase in yield of over 4 tons per acre.

This increase was economically very profitable. The efficacy of applying a late dressing of nitrogen to ratoon canes in February or March, the method being to spread the salt uniformly over the interline, thus appears to be fully justified. The writer understands that Mon Désert S. E. are now adopting this method as a routine procedure in the fertilizing programme of the estate.

There was no significant deterioration in the quality of the juice, following the treatment,

NEW EXPERIMENTS ON THE TIME OF APPLICATION OF NITROGEN, POTASH AND PHOSPHATE

The lack of sound information as to the magnitude of the beneficial effects produced by applying fertilisers at different times, and the greatly increased yields produced by additional late doses of Nitrogen led the writer to initiate an experiment to determine the best time of application for the three most important plant foods. The experiment consists of the following treatments for each of the elements N. K. and P.

(1) All applied at planting
(2) „ 3 months
(3) „ 6 „
(4) „ 9 „
(5) ¼ applied at planting, ¼ at 3 months, ¼ at 6 months, and ¼ at 9 months.

The canes have been planted in steel drums of 22 gallons capacity, there being 24 drums for each element, making 72 for the whole experiment. All the leachings from the drums are returned, and the moisture content of the soil is not allowed to fall below 30%.

It is hoped that information as to the relative effect of time of application on the growth and metabolism of the cane will be obtained. The experiment is similar to that successfully carried out on wheat by Watson at Rothamsted (vide Journ. Agric. Sci., Vol. XXVI, Pt. 3, July 1936, pp. 391–414).

EXPERIMENTS ON THE CONTROL OF ARROWING

The reduction of arrowing in the field by a heavy application of Nitrogen about 3 months before arrowing normally begins, has been successfully effected. Reduction or elimination of arrowing is the problem that interests the planter most, since growth ceases when arrowing begins. For the plant-breeder, however, the problem of controlling the time of arrowing is of greater importance since, if this is made possible, crossings which are at present impossible owing to a discrepancy in the time of arrowing, or to the non-arrowing of certain varieties, could be effected. Further experiments on this subject were carried out during the current year.

(1) *Injection Experiments.*—Following the method worked out by Roach at East Malling Research Station for the introduction of chemicals into fruit trees by injection, an apparatus was devised to introduce chemicals into the growing cane. A bore was made in the cane by means of a sharp cork-borer, and a close fitting glass tube bent into the form of a syphon inserted into the hole. The syphon discharged a solution into the cane, the solution being drawn slowly into the cane as a result of a water-deficiency induced by transpiration. Over a hundred canes were injected in this manner at the beginning of January, and records of the date of flowering kept. The substances mainly injected were Nitrogen (as urea), Potash (as K_2SO_4) and Phosphate (as KH_2PO_4 and NaH_2PO_4). A maximum quantity of 5 grams of urea, 3.5 grams of K_2SO_4 and 2 grams KH_2PO_4 was introduced into single canes by this method. Hot, dry weather is necessary for rapid absoption. Nitrogen was the only substance which had a significant effect on the time of flowering. In some instances arrowing was completely prevented by the introduction of large quantities of Nitrogen, and those which flowered were one week later than the controls. There was no significant difference in either the degree or time of arrowing when potash and phosphate were introduced.

Injection of sucrose (of which 20 grms was the maximum quantity introduced into the cane), glucose, ammonium molybdate (0.01%), Ferrous sulphate (0.01%), thio-urea (0.01%), uranium acetate (0.01%) and zinc sulphate (0.01%) had no effect on arrowing.

Many of the substances introduced produced very peculiar physiological effects. Nitrogen and potash had no apparent effects and no harmful effects were seen up to the maximum limits introduced. Phosphate caused firstly reddish streaks on the older leaves, followed by reddish streaks on the more mature leaves, but seldom on the youngest leaves. With large quantities those regions of the leaves which are streaked, subsequently die. Another remarkable effect of phosphate was to cause germination of practically all the root primordia, this being more marked below the injection than above.

With ammonium molybdate the whole cane turned brick-red in colour in 12 hours, and subsequently died. With uranium acetate the leaves become yellow, but do not die. Although interesting, these physiological effects do not appear to have any practical significance. It was not possible to induce arrowing in varieties which do not normally flower, by chemical injections, and it is not considered that the method holds any promise in the matter of controlling arrowing.

(2) *Vernalization Experiment.*—In view of the success which several Russian workers have obtained in promoting early flowering in certain economic crops by a suitable vernalization or iarovization treatment, it was decided to try this method with sugarcane. The variety BH 10[12 which never flowers at Réduit was used. The vernalization treatment was effected on single-eye cuttings. They were germinated between moist sacking for two days following a soaking in a saturated solution of lime. By this time, the buds had begun to swell, and the roots were just emerging. They were then placed at a temperature of 0— 5°C in an ice chamber in the dark, some for 30 days and some for 40 days. They were then transplanted into small pots of canes leaves, and allowed to develop in the greenhouse. At the same time untreated single-eye cuttings were planted.

There was a marked set-back in growth in the vernalised cuttings, some remained alive for several months but failed to develop further, even when conditions of temperature and moisture were most favourable. However, a large number of cuttings finally developed, and after 2 months in the green-house the vernalised and control plants were transplanted into the field (September 1st, 1936). At this time both sets of plants had just one shoot, no tillering having occurred. A month later the plants had established themselves well. A deeper green colour was apparent in the leaves of the treated plants. Counts of the number of tillers were made on November 10th and December 1st with the following results:—

	Vernalized	Controls
Nov. 10th	5.33	4.40
Dec. 1st	11. 2	10. 0

The vernalization treatment thus appears to have had a slight effect on tillering. Any effect on arrowing will probably not be apparent until 1937.

During the year three Bulletins of the Physiological Division were issued for publication. Three papers were published in the Empire Journal of Experimental Agriculture, and several papers in " La Revue Agricole de l'Ile Maurice."

H. EVANS,
Physiological Botanist.

January, 1937.

APPENDIX—LIST OF PUBLICATIONS OF THE SUGARCANE RESEARCH STATION, DEPARTMENT OF AGRICULTURE.

I.—BULLETINS

Bulletin No. 1 :

(*a*) Results of Manurial Experiments harvested in 1931 and 1932 ;
(*b*) Results of Variety Trials harvested in 1931 and 1932 ; by N. Craig, M.Sc. ... ... (1933)

Bulletin No. 2 :

Preliminary Investigations of the Growth Rate of the Sugarcane ; by A. Glendon Hill, B.A., B. Agr., A.R.C. Sc. I., and H. Evans, Ph. D. (out of print) ... ... (1933)

Bulletin No. 3 :

Some Preliminary Data concerning the best Shape and Size of Plot for Field Experiments with Sugarcane ; by H. Evans, Ph. D. (out of print) ... ... (1934)

Bulletin No. 4 :

Some Properties of the Sugarcane Soils of Mauritius ; by N. Craig, M.Sc. (English and French editions) ... ... (1934)

Bulletin No. 5 :

Studies on Root-Exudation and Root-Type in Sugarcane by H. Evans, Ph.D. (out of print) ... ... 1934)

Bulletin No. 6 :

Investigations on the Root-System of Sugarcane Varieties ; by H. Evans, Ph. D. ... ... (1935

Bulletin No. 7 :

Investigations on the Course of Growth in a Virgin or Plant Crop of Sugarcane ; by H. Evans, Ph. D. ... (1935)

Bulletin No. 8 :

The Maintenance of First-Year Characters in New Sugarcane Clones ; by A. Glendon Hill, B.A., B. Agr., A.R.C.Sc.I. ... ... (1935)

Bulletin No. 9 :

Base Exchange Relationships in Mauritius Soils ; by N. Craig, M.Sc.... ... ... (1935)

Bulletin No. 10 :

Some Data on the Effect of a late heavy Dressing of nitrogenous Fertiliser on the Growth and Metabolism of Sugarcane in Mauritius ; by H. Evans, Ph.D. (English and French editions) ... ... (1936)

Bulletin No. 11 :

Sugarcane in Mauritius : A Revue of the present Position with Respect to its Cultivation and Manuring ; by N. Craig, M.Sc. (English and French editions)—(in press)

Bulletin No. 12.

Further Investigations on the Root-System of Sugarcane; by H. Evans, Ph. D. (English and French editions)—(in press).

Bulletin No. 13:

An annotated Catalogue of Sugarcane Varieties in Mauritius; by A. Glendon Hill, B.A., B. Agr., A.R.C.Sc.I.—(in press).

Bulletin No. 14:

A preliminary Study of Root Characters as affecting Drought Resistance in two Sugarcane Varieties and in their Seedlings; by H. Evans, Ph. D. (English and French editions)—(in press)

II.—REPORTS

Report on a Visit to the Proefstation-Oost-Java in March–April, 1930; by A. Glendon Hill (out of print).
First Annual Report, 1930 (out of print).
Second Annual Report, 1931.
Third Annual Report, 1932.
Fourth Annual Report, 1933.
Fifth Annual Report, 1934.
Sixth Annual Report, 1935.

For publications of the Department of Agriculture, other than those of the Sugarcane Research Station, application should be made to the Director of Agriculture, Réduit.

75/7/37 Agri.—375